THE INDEPENDENT GUIDE TO IBM-STANDARD PERSONAL COMPUTING

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MAGAZINE

VOLUME 8 NUMBER 5
MARCH 14, 1989

Inside the World Of Numbers

Powerful Tools for Common Problems

- Serving Science And Business: 49 Statistical Analysis Packages From Simple To Advanced
- Beyond Presentation Graphics: 14 Flexible Tools For Visual Analysis
- Higher Math, Less Effort: 16 Equation Solvers

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Introducin

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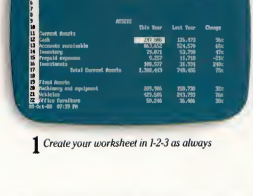

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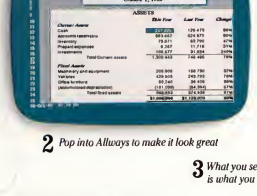

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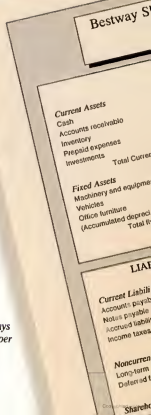

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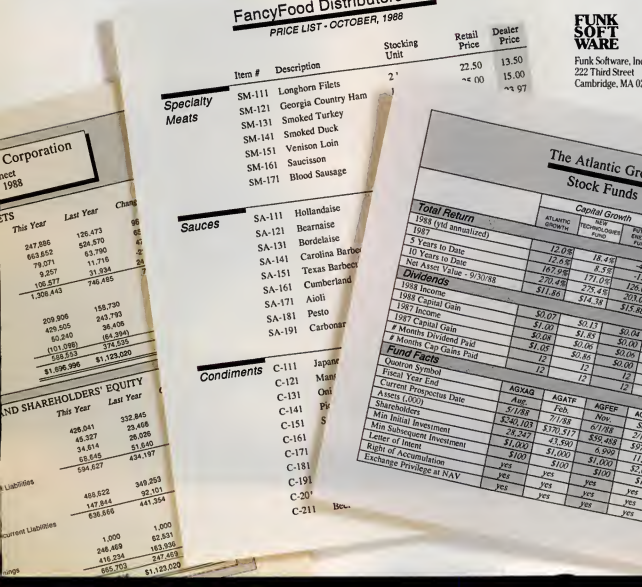


This is abou

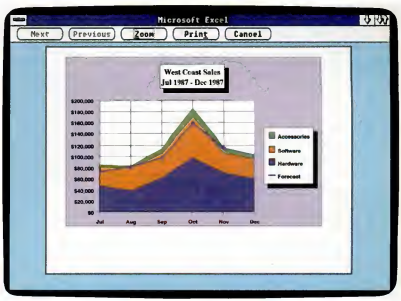
At this moment, millions of Lotus® 1-2-3® users are faithfully awaiting the arrival of a product called Release 3. A character-based product that promises greater power and greater productivity for serious spreadsheet users.

As soon as it gets here.

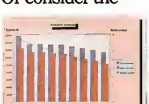
In the meantime, we have a question:

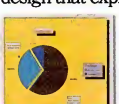
If Release 3 is in fact character-based, and the entire personal computing industry continues moving toward *graphics*-based environments, is it wise to wait for Release 3? Or consider the alternative.

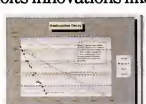
Microsoft Excel. Or, how to see Lotus 1-2-3 Release 3 from a whole new perspective.



Actually, you can do both. Because you have nothing to lose by seeing the other side of the spreadsheet story, and trying it for yourself.

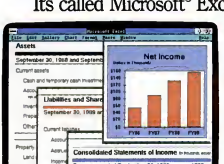






As you know, with 1-2-3 your ability to customize worksheets and charts is limited. As you may not know, with Microsoft Excel the possibilities are limitless.

It's called Microsoft® Excel. The spreadsheet specifically designed for graphic environments—the industry's emerging standard. Five minutes in front of a demo will show you the fastest, easiest, most enjoyable way to crunch your numbers. Thanks to an incredibly intuitive design that exploits innovations like Microsoft Windows, OS/2 Presentation Manager and, of course, the Macintosh.®

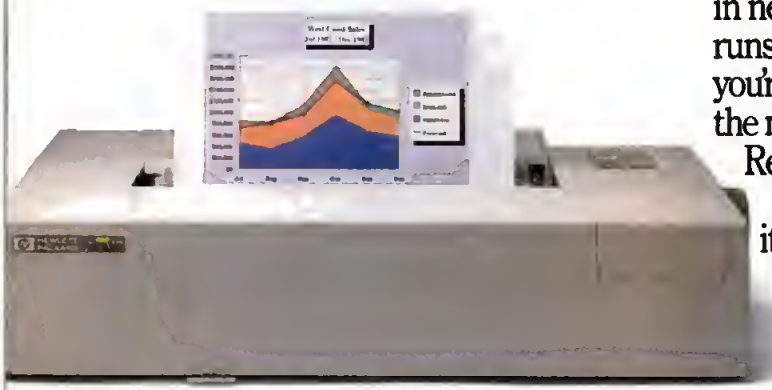


Unfortunately, 1-2-3 won't let you move, size, and link an unlimited number of files at the same time. Fortunately, Microsoft Excel will.

You're a loyal Lotus user. If you're a bit skeptical, we fully understand that. We also anticipated it. So we've made sure your hard-earned equity in 1-2-3 is not

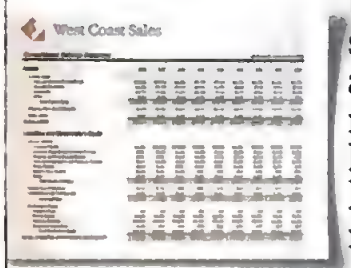
obsolete. In fact, we've not only made a transition to Microsoft Excel attractive, we've also made it easy: Microsoft Excel actually reads and writes

t Lotus 1-2-3.



No more wasted trips to the printer. Microsoft Excel comes with Print Preview for true WYSIWYG. Unlike Release 3.

1-2-3 files and even helps translate macros. It also offers the convenience of 1-2-3 on-line help—so you can expect a surprisingly smooth transition. In fact, the slash key you punch to access your 1-2-3 commands is the same key that can access Microsoft Excel commands—you don't have to relearn a thing.



Yes, graphics-based Microsoft Excel was designed around a mouse. You can also use it without one.

Another issue: hardware.

As Lotus may or may not have told you, Release 3 will need a substantial investment in new hardware. The same hardware that runs Microsoft Excel. All we're saying is, if you're committing to new machines, make the most of those new machines. Something Release 3 simply won't.

But, using is believing. So we've made it convenient to get a sample of Microsoft Excel in your hands. Simply call us at (800) 541-1261, Dept. J14 for a free sample disk of your own. It's worth the call. It's worth the experience.

In fact, we're so confident about Microsoft Excel that we're offering a no-questions-asked, money-back guarantee good through January 1990. Which means we're actually willing to guarantee our current technology against Lotus technology that isn't even available yet.

For even more convincing, call for a sample disk. The disk is free. But the experience is priceless.

All of which brings us to a decision millions of you are about to face:

Upgrade to character-based Release 3, or upgrade to the power and simplicity of a graphics-based spreadsheet. We're not saying it's an easy decision.

Just an inevitable one.

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WHAT'S INSIDE

Catherine Miller and Robin Raskin undertake our numerical blockbuster.

The seed for this issue was planted nearly a year ago by *PC Magazine*'s publisher and editor-in-chief, Bill Machrone. In the February 16, 1988, issue, in the column "Serving the Scientist," we explored science's role in our industry for the first time.

Responding to a letter from Bill Joyce, a scientist at AT&T Bell Labs, Machrone addressed many of the concerns and desires of the scientific community. Machrone's editorial inspired one of our most prodigious undertakings, *PC Magazine*'s first Statistical and Numerical Analysis Software Blockbuster. As for each one of you who writes in with comments or speaks to us through PC MagNet, our online interactive forum, keep after us. We listen to your suggestions. Just ask Bill Joyce.

Associate editor Catherine Miller and contributing editor Robin Raskin tackled this challenging blockbuster. They uncovered over 200 number-crunching packages before deciding upon the 80 statistical analysis, math toolbox, and scientific graphing packages reviewed in this issue.

PC Labs created five real-world test procedures to evaluate the 49 statistical analysis packages. These five tasks are comparable to our "Suitability to Task" ratings for word processors and desktop publishing software. (See the sidebar "A Day in Five Lives: How We Tested Statistical Analysis Software," appearing in "Statistical Software for the PC: Testing for Significance.")

To ensure our usual high standards in this vast endeavor, PC Labs combined its technical know-how with outside experts to assist in reviewing the unusually large number of packages. Our list of contributors reads like a Who's Who of American scientists, Wall Street financiers, statisticians, research scientists, bankers, managers, and university professors, as well as our own in-house computer experts.

On the lighter side, PC Labs director John Dickinson won a long-running argument with Raskin. Our contributing editor had only one phone line in her home. (Many *PC Magazine* editors have voice and data lines at home, with more editors each day adding a third line dedicated to fax or voice mail.) Dickinson's perseverance won out, leading Raskin to challenge phone-company bureaucracy and an angry building superintendent to get a second line installed in her Manhattan apartment *quickly*, no small undertaking.

The data line arrived just in time for Raskin to receive all those late-night MCI messages. Raskin is now tuned into the *PC Magazine* heartbeat around the clock.

—Matt Ross

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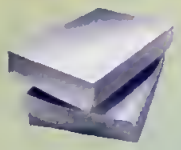

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All three BigBin models are available exclusively through Laser Connection™ dealers. For more information on how BigBin can maximize your paperhandling, call Laser Connection at **1-800-523-2696** for the dealer nearest you.

And be sure to ask for *The Sourcebook*™—our exclusive catalog filled with the latest laser printer products and enhancements.

*Fits Canon SX and Ricoh 4150 engines.

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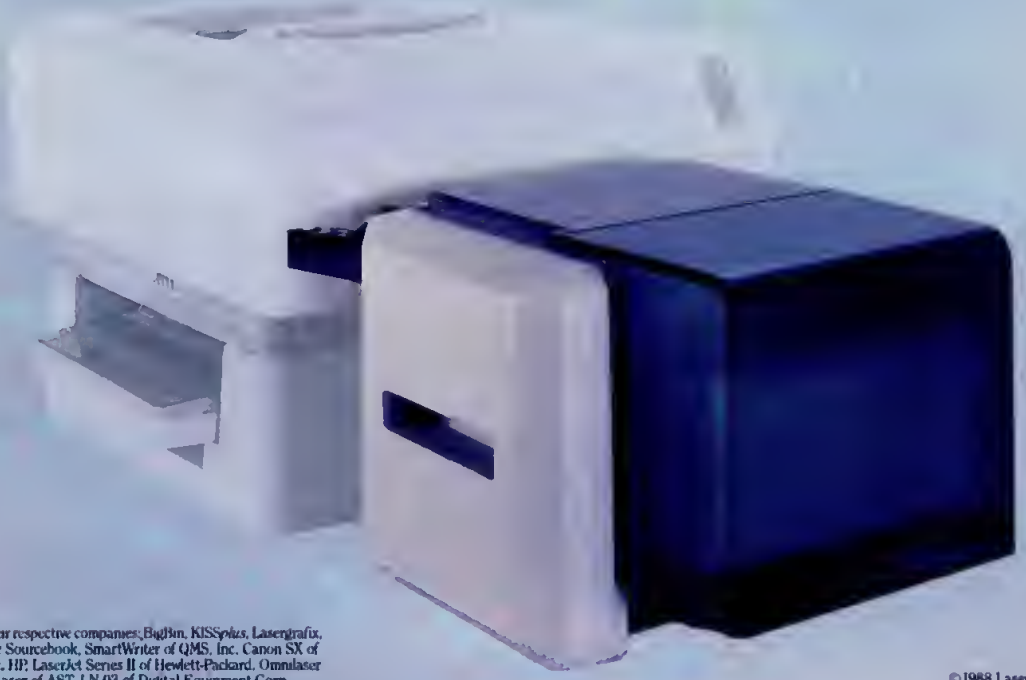

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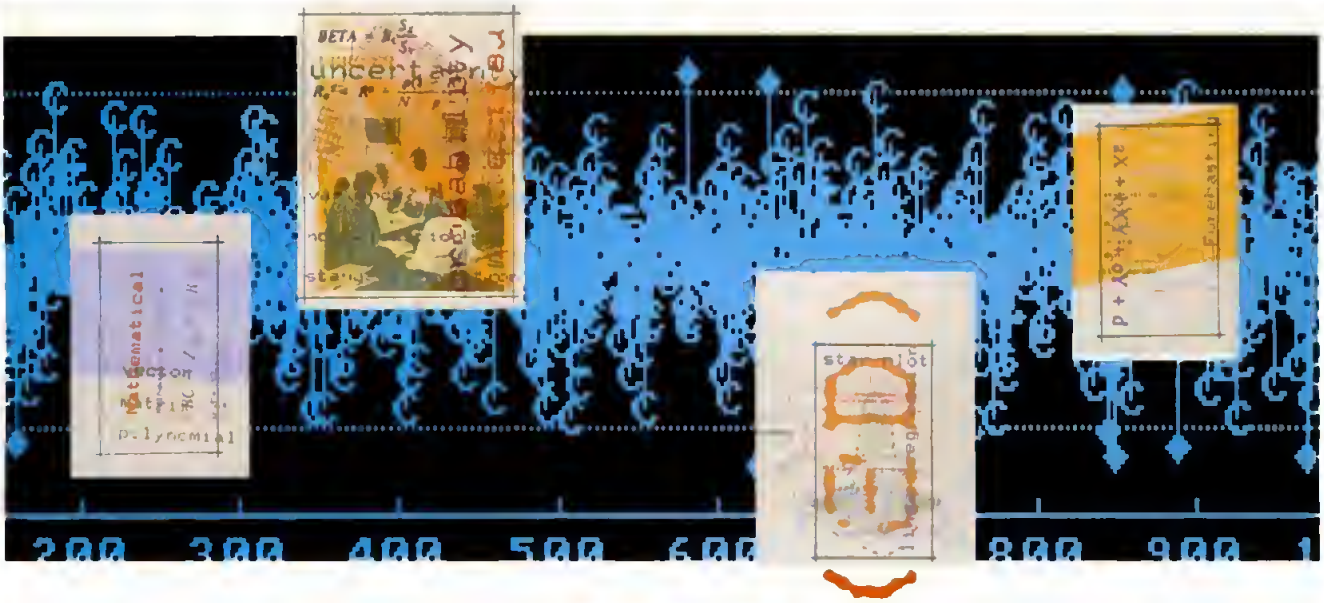

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PC MAGAZINE

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- *Microsoft Stat Pack, Small Business Consultant*
- *Compile 1-to-C* generates standalone worksheets in C
- *Laser-Ready:* fill-in-the-blanks LaserJet forms
- XyQuest adds point-and-shoot menus to *XyWrite III Plus*
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In this installment of our two-part series on personal income tax preparation software, tax expert Laura Lou Meadows reviews the following five products:

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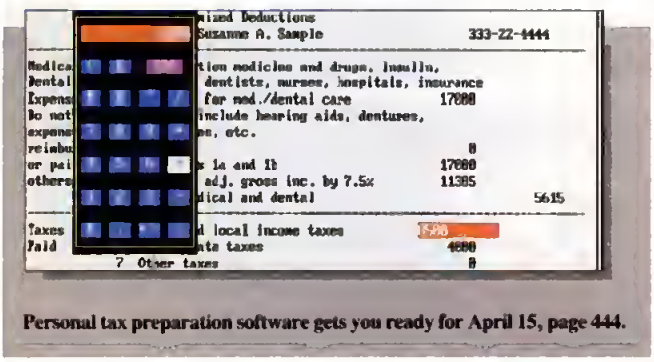

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BPA

Mother Nature Can Teach Us A Lot About Hard Disks.

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	80 MB 1:1	$2995	$3195	$3995	$5995
	110 MB ESDI	$3295	$3395	$4295	$6295
	150 MB ESDI	$3495	$3595	$4595	$6595
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CIRCLE 263 ON READER SERVICE CARD

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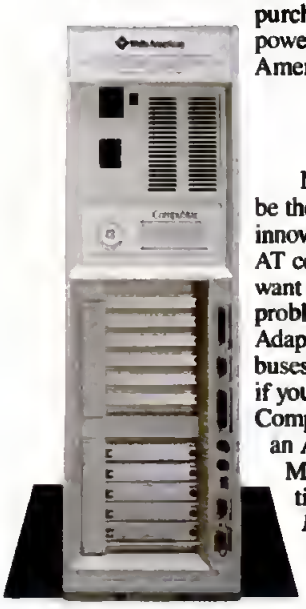

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The CompuStar is also easily expanded. That's because there are *seven* CompuStar disk/tape compartments — six accessible from the front and an additional full-height bay inside. All this in a sleek, compact tower design that will leave *more* room on your desktop than any of the so-called "desktop" models.

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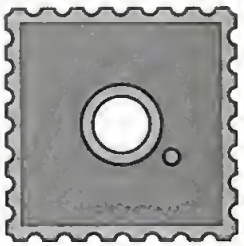
CIRCLE 515 ON READER SERVICE CARD

LETTERS TO PC MAGAZINE



IDENTITY CRISIS

At the end of a review that included my product, *Genealogy db* (After Hours, *PC Magazine*, December 13, 1988), the author stated, "It could even be rated as a 'buy,' but beware of its reliance on you to remember ID numbers." In no way does *Genealogy db* rely on the user to remember ID numbers. The reviewer understood this, since earlier in the article he wrote, "Luckily, there is some help if you can't remember an ID number—just type a minus sign and the program enters its search-by-name mode."

The two statements are contradictory. And unfortunately, people tend to remember the last thing they read. Anything good said about the product earlier in the review suffered from that last "beware."

Joseph J. Borrello
Geneware Inc.
Covina, California

While it's true that the user doesn't have to remember *ID numbers when using* Genealogy db, *manipulation of the data is by ID number and not by name. This is the inconvenience alluded to in my choice of the word "beware."*—Donald B. Trivette

NIX TO UNIX

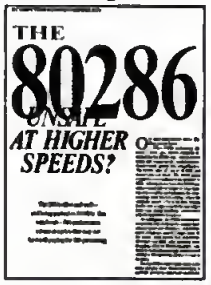
Wendell Anderson's head must be buried in the sand for him to state that "one can proficiently use Unix-based applications without regard for the complexities of the underlying operating system" (Letters, *PC Magazine*, November 29, 1988).

Has he tried the user-hostile XEDIT under CMS or, worse yet, *VI* under Unix? How many inexpensive, productive, and easily obtainable software tools and applications are available for Unix or IBM's CMS? Anderson and people like him are the ones who stood dumbfounded on the sidelines while others with vision forced PCs into the workplace because they were fed up with the mainframe mentality.

Jeff Epstein
Pomona, California

DEFENDING THE MICRO CHANNEL

Bill Machrone continues the *PC Magazine* tradition of throwing brickbats at the Micro Channel and PS/2s ("Computer Buyers Survival Guide," *PC Magazine*, December 13, 1988). What is wrong with the Micro Channel other than its being slightly different?



Sure, you can't take boards out of an old machine and put them in a new PS/2, but does anybody really want to do that? You don't have to be a hostage of IBM (as Machrone suggests) to buy a Micro Channel PS/2. PS/2s come with their video adapter and ports on the motherboard, and there is no lack of 100 percent compatible software.

Peter H. Strong
Los Angeles, California

PREVENTIVE MEDICINE

I am interested in finding an antiviral program "flu shot" for my PC. Do you have any information?

Joyce Altman
Port Chester, New York

Flushot Plus *is a shareware program created by Ross M. Greenberg. FSP14.ARC is available on PC MagNet in two areas: in the utilities database and in library 8 of the Utilform. For information on how to join PC MagNet, see the Productivity section.* —Ed.

REORIENTING WORDSTAR

Edward Mendelson's review of *WordStar Professional* 5.0 (First Looks, page 46, *PC Magazine*, November 29, 1988) decries the fact that the page preview feature accommodates only an 8½- by 11-inch page, and only in portrait orientation. In fact, this can be changed, although not from within *WordStar*.

The page size for preview is established by an entry in a configuration file called FONTID.CTL. No installation program is provided to change the settings in that file. The entries are in text form and are edited using a text editor, such as *WordStar*, in the nondocument mode. The documentation is in the file itself.

Douglas A. Kerr
Dallas, Texas

OUT ON A LIM

In your software reviews, it would be very helpful if there were a comment about whether EMS 4.0 is used to full advantage. The specification is of little help to end users if it is ignored because it takes a little effort. If OS/2 and 386 machines get all the attention, where are priorities going to be when allocating development resources?

Douglas Sauer
Cincinnati, Ohio

GET OFF MY LAN

How could John C. Dvorak be so narrow-minded and misinformed about LANs ("The Agony of Networks," *PC Magazine*, December 13, 1988)? Usually his views combine good (mostly accurate) in-

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CIRCLE 145 ON READER SERVICE CARD

■ LETTERS

formation, wit, and a flair for writing. What happened this time? He has lent new meaning to the words *distortion* and *misrepresentation*.

Come on, John! Redeem yourself! Your colleague Jim Seymour might even offer to tutor you if you are really nice.

Brett Spengler
Riverton, Wyoming

A MIDI OMISSION

As an amateur musician, I was surprised that you neglected to mention *SongWright IV* ("A MIDI Musical Offering," *PC Magazine*, November 29, 1988). I have been using this program regularly for years. It has many of the features of *Personal Composer System/2*, yet costs under $100. It might not have all the power that a professional studio musician might need, but for people who use a PC for business and pursue music as an avocation, it is perfect.

Doug Smith
Long Island City, New York

EQUAL TIME FOR SCIENTISTS

I have been frustrated to see very little in the computer magazines that addresses the needs of scientists in applications such as graphics, spreadsheets, and databases.

Scientists would welcome reviews of more specialized hardware and software for such applications as direct acquisition of data from instrumentation, morphometric analysis, and molecular modeling. I hope that *PC Magazine* will take the lead in addressing the needs of scientists, who surely represent a significant segment of the computer-using public.

Rudy J. Richardson
Ann Arbor, Michigan

■ Isn't a person better off spending more money on memory than on the questionable performance of a 386?

DVORAK VS. COBOL, ROUND 2

Three readers responded to previous attacks on COBOL by John C. Dvorak (Letters, *PC Magazine*, December 13, 1988) only to receive a petulant, sarcastic comment from him.

Anyone who knows anything whatsoever about computers—and Dvorak has proved that he is not a member of this group—knows that COBOL is procedural and can be termed a language only when using the broadest definitions. Every language was developed to solve a particular class of problem, and COBOL was designed for business applications. COBOL was, and is, the best tool that programmers have for accounting.

Sydney B. Self
Sudbury, Massachusetts

WHEN DOES THE FUTURE BEGIN?

All I seem to read lately are articles proclaiming that 386s are the only machines worth purchasing, and yet, for the cost, they don't seem that hot. The problem seems to be that they won't run any extensive windows-type applications without more memory than 640K. Isn't a person better off spending more money on memory than on the questionable performance of a 386?

Richard Nicholls
Stamford, Connecticut

You cite numerous future benefits and coming price reductions as your justification in recommending "an 80386-based computer" as Editor's Choice ("The 80286: Unsafe at Higher Speeds?" *PC Magazine*, December 27, 1988). For those who need to buy equipment *now*, the best choice is the PC that provides the best reliability, price, and performance *today*.

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February 14, 1989

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CIRCLE 233 ON READER SERVICE CARD

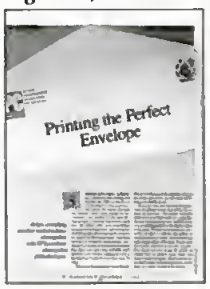
■ LETTERS

applications and justifiable for many others, but in no way are they a cost-effective substitute for all 286-based machines. When (and if) your predictions start coming true, we'll gladly start paying a little more money for a 386-based PC.

W. J. Del Vecchio
Old Greenwich, Connecticut

THE ENVELOPE, PLEASE

It has been over 3 years since anyone in our company has had anything to do with addressing an envelope ("Printing the Perfect Envelope," *PC Magazine*, December 13, 1988). Might I suggest preprinted window envelopes as a much cheaper solution than the $50 programs included in your review? For a cost differential of $50, I estimate we can buy about 10,000 window envelopes—and absolutely zero ballpoint pens.



Tony Lima
San Carlos, California

BUT IT STILL CAN'T THINK

I would like to point out that using a computer as a "tool for pseudovalidation of reality" in television advertising is not new ("Of Course It's True: My PC Says So," *PC Magazine*, December 27, 1988). Commodore tried it in an amusing fashion several years ago when it "asked" an IBM PC, an Atari, and an Apple II which computer was the best buy and each "recommended" the Commodore 64.

David Stafford
Santa Cruz, California

■ When (and if) your predictions start coming true, we'll gladly start paying a little more money for a 386.

DON'T BLINK

I was disappointed in Jonathan Matzkin's "cursory" review of the *No-Squint Laptop Cursor* (First Looks, page 56, *PC Magazine*, December 13, 1988). He obviously did not gather the central sophistication of the program: that it slows the hardware-determined "hummingbird" cursor to a blink rate that can be reproduced clearly by the relatively slow screens of even the most unreadable LCD laptops.

This is not a simple or inconsequential accomplishment on the part of Ken Skier, and for a writer like myself, it is well worth the $39 price tag.

Jeffrey Baker
Cambridge, Massachusetts

AROUND THE WORLD WITH ARCHE

How can you say that "Arche designs and manufactures all of its own components here in the United States" ("The Size Is Right: Packing 386 Power into Sleek PCs," *PC Magazine*, November 15, 1988)?

Opening the case of an Arche computer is a lot like taking a course in geography. Even the keyboard was made in Thailand, and the picture you include in the article shows a label that is stamped "Made in Taiwan."

Randy Tempel
St. Louis, Missouri

CORRECTIONS/AMPLIFICATIONS

The correct phone number for Microsoft technical support is (206) 454-2030 (Languages, *PC Magazine*, December 13, 1988).

The correct command that should be typed at the DOS prompt to create a zero-length file for use with the *WordStar Professional* envelope-printing macro is: rem > env.tmp ("Printing the Perfect Envelope," *PC Magazine*, December 13, 1988).

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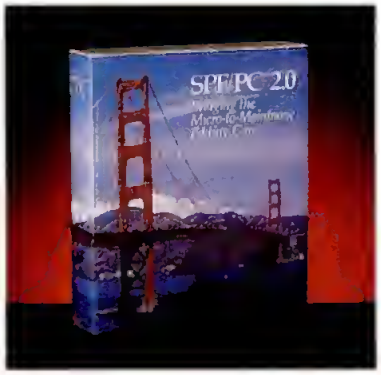

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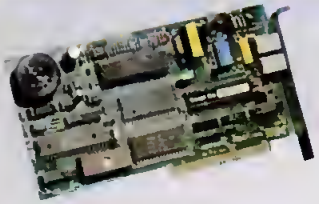

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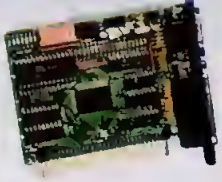

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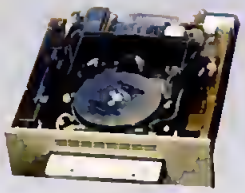

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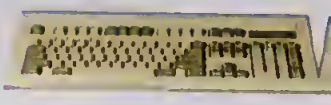

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CPU	8088-1	80286	80286	80386	80386
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BIOS	Phoenix	Phoenix	Phoenix	Phoenix	Phoenix
Norton SI Rating v 4.0	2.1	11.2	13.7	17.6	22.0
Wait State	0	0	0	0	0
Standard Memory	640K	512K	512K	1MB	1MB
Shadow BIOS	—	—	—	384K	384K
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Expansion Slots: 16-bit	—	6	6	4	4
Expansion Slots: 8-bit	8	2	2	3	3
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Device Bays (Exposed/Internal)	2 Exp./2 Int.	3 Exp./2 Int.	3 Exp./2 Int.	3 Exp./2 Int.	3 Exp./2 Int.
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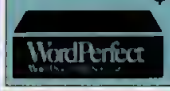

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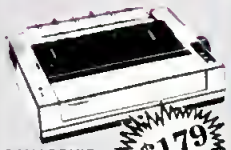

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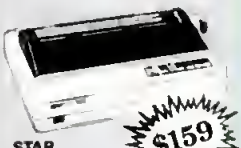

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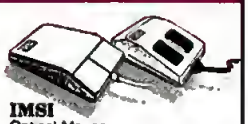

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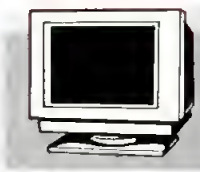

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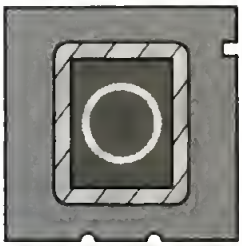

PC ADVISOR

Advice on unattended printing of 100 spreadsheets; suggestions for TSR programs that protect against viruses; and ways to increase memory for Lotus 1-2-3.

TIRED OF WAITING ON PRINTERS

Is it possible to queue multiple *Lotus 1-2-3* spreadsheets for unattended printing? The solution I am not looking for is to save each spreadsheet as an ASCII file and then print them out using the PRINT command in a batch file. This unacceptable method forces one to attend to each spreadsheet while it is being saved in ASCII format. I must print out 100 spreadsheets. Is there a way to do this without baby-sitting the computer?

Ray Battalora
Lakewood, Colorado

Let's face it, if there is anything a computer does well, it's repetitive tasks. So unattended printing of multiple spreadsheets is not a problem—if you have the right software.

What you need to queue your files for printing is a print spooler. You can send the files to a RAM disk or extended memory if you have sufficient memory to hald all of them, or else you can send them to your hard disk. These files will wait in memory until you give the signal to print. Then they will print out successively. Best of all—you don't add any extra steps to your usual procedure of printing a 1-2-3 *worksheet.*

A few print spoolers that I would recommend are Spool-Master *from Software Masters (6352 Guilford Ave., Indianapolis, IN 46220; (317) 253-8088), which has a suggested retail price of $69.95;* Printer Genius *from NOR Software (527 Third Ave., #150, New York, NY 10016; (212) 213-9118), which sells for $89; and* LaserTORQ, *a print spooler that's designed for laser printers, from LaserTools Corp. (3025 Buena Vista Way, Berkeley, CA 94708; (415) 843-2234), which has a list price of $99.*

Once you start using a print spooler, you will probably become interested in further automating your printing procedures. Don't forget that Lotus 1-2-3 *itself provides the capability to automate many repetitive tasks with its mocros and command language.*

MORE MEMORY FOR 1-2-3

I use *Lotus 1-2-3* to analyze, project, and control our operation. Works great! However, the projection file runs over 180K. With some of these files I'm almost out of memory.

I'm thinking of buying two new AT clones to get more memory (1MB) and speed. One "expert" says I can use the additional memory in *1-2-3*, another "expert" tells me I'll still be limited to 640K.

■ If there is anything a computer does well, it's repetitive tasks. Unattended printing of 100 files isn't a problem with the right software.

What gives? If I change to a 286 or 386, will it increase usable memory in *1-2-3*?

Jack D. Flanders
Mount Clemens, Michigan

If you are using Lotus 1-2-3, *Version 1A, there is nothing you can do to gain more memory for it. If, however, you have Version 2.0 or later, you can take advantage of expanded memory. For the most part, this means you can produce larger worksheets without running out of memory.*

An expanded memory board that can be used in either an XT or an AT-compatible computer is the Above Board PS/286 from Intel Corp. (5200 NE Elam Young Pkwy., Hillsboro, OR 97124-6497; (800) 538-3373), which has a suggested list price of $695 with 512K RAM. Although the board has an AT-style 16-bit edge connector, Intel provides a jumper that converts the board to 8-bit operation for use with 8088- or 8086-based computers. This board was reviewed along with other AT-style boards in the October 11, 1988, issue of PC Magazine. *The last time XT-style expanded memory boards were reviewed was in the June 10, 1986, issue.*

A less expensive alternative to an expanded memory board is a software product called an expanded memory emulator. This type of program is essentially an expanded memory manager that works without an expanded memory board. On an AT-type computer with 1MB RAM, 640K is conventional memory and 384K is extended memory. An expanded memory emulator uses the 384K of extended memory. On an XT-type computer, there is no ex-

■ PC ADVISOR

tended memory, so the emulator uses the hard disk to emulate expanded memory.

An expanded memory emulator to consider is V-EMM *from Fort's Software (P.O. Box 396, Manhattan, KS 66502; (913) 537-2897). Its list price is $89.95. Expanded memory emulators were last reviewed in the March 31, 1987, issue.*

TSR VIRUS PROTECTION

Is there a TSR (terminate and stay resident) program available that can identify Trojan horse or virus programs? It should have the following attributes: (1) it warns you if the COMMAND.COM, FORMAT.COM, or important internal interrupts are about to be accessed (which could result in a trashed hard disk), and (2) it identifies counters (number of accesses, dates, time of day, and so forth) that could activate the Trojan horse at a specified time?

Carlos Moore
Lynwood, Washington

There are TSR programs available that will warn you if the COMMAND.COM, FORMAT.COM, or other important system files or important system interrupts are about to be accessed. However, these do not also search for counters that could possibly trigger a Trojan horse program. (A Trojan horse program is like a virus without the ability to duplicate itself.) Ross Greenberg, author of Flushot Plus, *intends to include this as an optional feature in the next version of the product. Having a message pop up every time a program looks for a date, or accesses system interrupts could get very annoying.*

Three TSR programs that combat viruses were reviewed in the First Looks section of the June 28, 1988, issue of PC Magazine. *The products were* Flushot Plus *from Software Concepts Design (594 Third Ave., New York, NY 10016; (212) 889-6431), which is shareware ($10 registration fee);* Mace Vaccine *from Paul Mace Software (400 Williamson Way, Ashland, OR 97520; (800) 523-0258), which sells for $20; and* Vaccine, *Version 2.0, from WorldWide Data (17 Battery Pl., New York, NY 10004; (800) 643-3000, ext. 123; (212) 422-4100), which sells for $79.95.*

In an upcoming issue, PC Magazine *will review the latest releases of programs designed to fight viruses. You should also realize that one of your best defenses against a virus attack is to back up your hard disk on a regular basis. And don't destroy old backup copies right away—they may come in handy if you inadvertently back up an infected disk.*

ASK THE ADVISOR

Send your questions to PC Advisor, *PC Magazine,* One Park Avenue, New York, NY, 10016, or upload to PC MagNet (see the Utilities column for access information). Please specify your equipment.

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CIRCLE 231 ON READER SERVICE CARD

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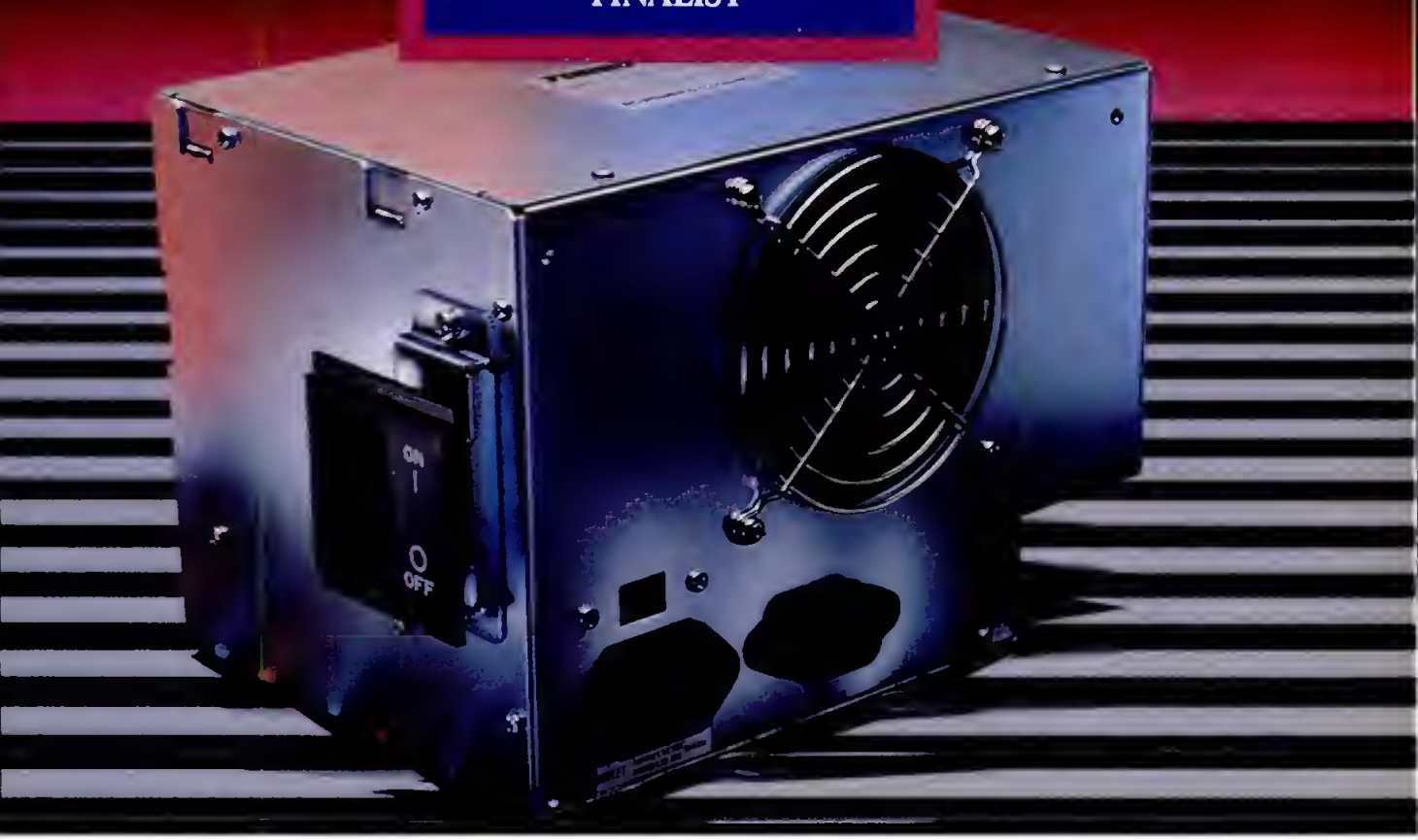
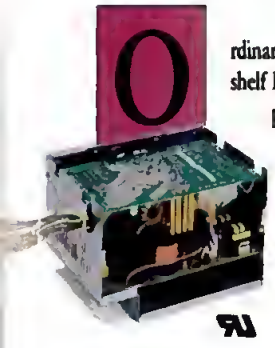


A standard power supply just isn't enough.



Ordinary power supplies, like the ones found in off-the-shelf PCs, will not meet the demands of today's high-performance systems. For serious business applications, you need a power supply that will not skip a beat during a hard disk access or when the line voltage sags. One that actually allows the use of all those slots and drive bays you paid for. One that is engineered for uncompromised performance, reliability, and safety.

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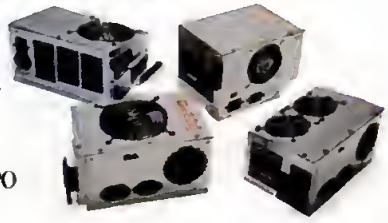

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CIRCLE 473 ON READER SERVICE CARD

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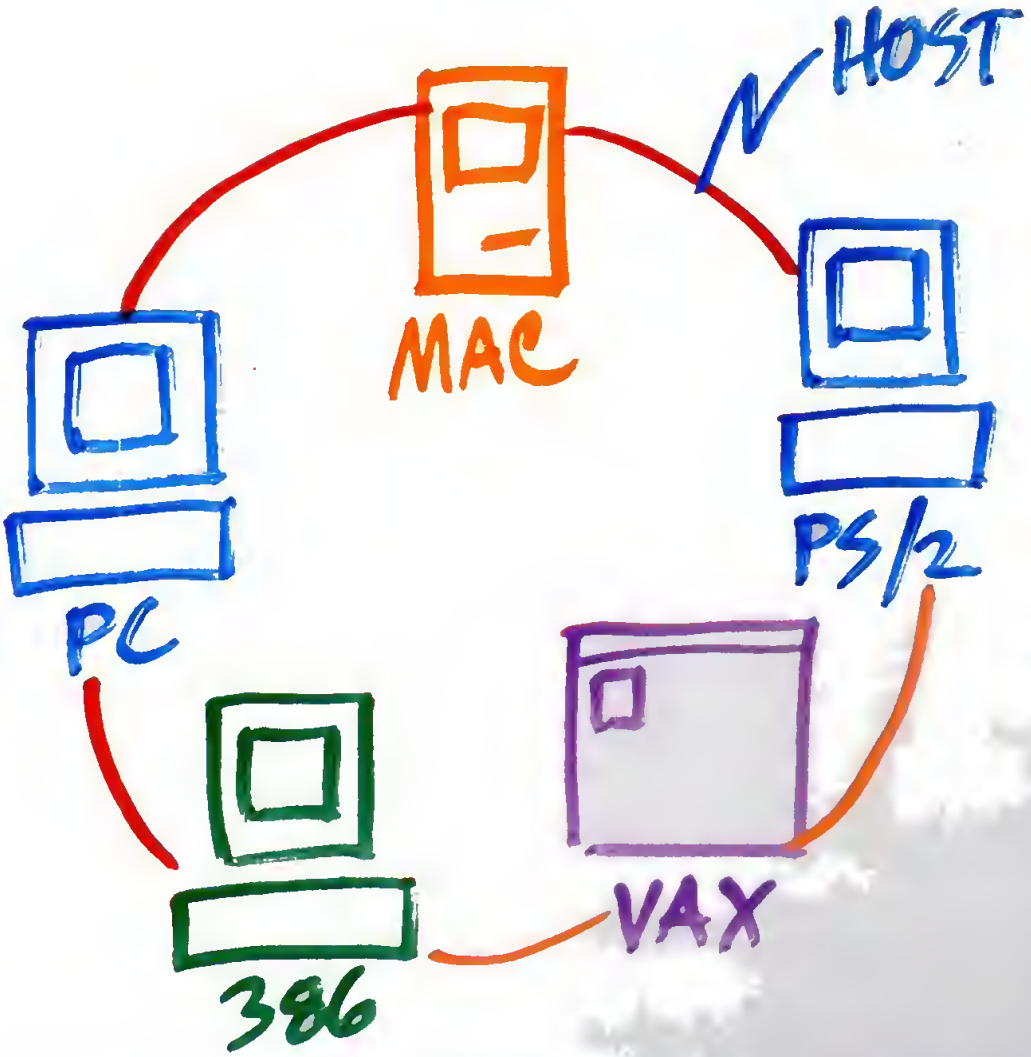

and you can choose all of these.

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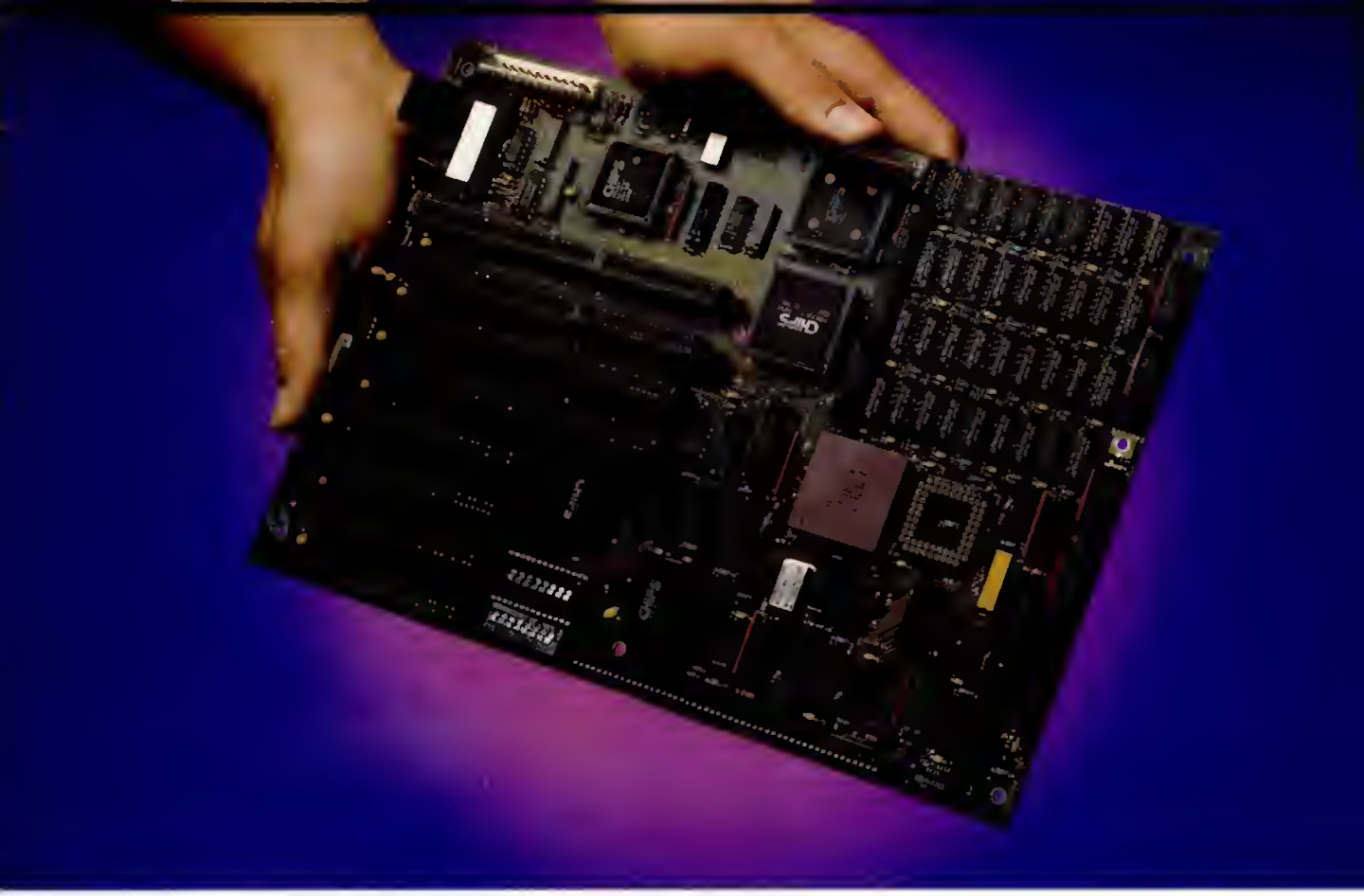
CIRCLE 103 ON READER SERVICE CARD



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CIRCLE 276 ON READER SERVICE CARD

PC MAGAZINE FIRST LOOKS

IBM LAN Manager Implementation: IBM Frills, for IBM Equipment Only

PC HANDS ON

BY FRANK J. DERFLER, JR.

IBM's *OS/2 LAN Server*, the Big Blue version of Microsoft's *LAN Manager* software, has hit the street and has lots of folks peeking out from behind their windows. *LAN Manager* is the generic network operating system jointly developed by Microsoft and 3Com that is or will soon be remarketed in various forms by companies including 3Com, NCR, DCA, Torus Systems, and IBM. While each company enhances the product and adds value to it in different ways, all versions of *LAN Manager*, including IBM's *LAN Server*, can interoperate on a network.

Because *LAN Server* is an OS/2 application and because IBM's OS/2 Extended Edition is hardware-specific, *LAN Server* can run only on IBM brand-name 80286 or 80386 machines. However, it is important to understand that OS/2 is required only on the system acting as the server. Non-IBM workstations can link to the network and run under any current version of MS-DOS.

In evaluating the strengths and weaknesses of *LAN Server*, there are two interesting comparisons we can make: First, we can look at *LAN Server* to see what value IBM has added (or changes it has made) to Microsoft's generic *LAN Manager*. Second, we can compare *LAN Manager* with today's best-selling network operating system, Novell's *NetWare*. The first view is important to people who want to be ready to use the power *LAN Manager* contains for creating distributed applications. The second view is important to anyone planning a major network purchase in the next 12 months.

All of the versions of *LAN Manager* are identical in the most important ways. Applications such as electronic mail or gateways written for NetBIOS will run on all *LAN Manager* systems. A DOS or OS/2 workstation can simultaneously use servers running under different versions of *LAN Manager* and IBM's *PC LAN*.

(continued on page 35)

Xerox Presents: All Dressed Up and Few Places to Output

PC HANDS ON

BY TOM STANTON

If you're expecting some slick compatibility scheme between Xerox's veteran desktop publishing package, *Ventura Publisher*, and its new presentation graphics package, *Xerox Presents*, be prepared for a few disappointments. Whereas *Ventura Publisher* runs under *GEM*, *Xerox Presents* runs under *Microsoft Windows* and doesn't even offer a *Ventura*-compatible output file format.

But don't write off *Xerox Presents*, particularly if you don't use desktop publishing. While Xerox has a few things to learn, its entry into presentation graphics rates impressive enough to give *Harvard Graphics* and Lotus's *Freelance* a run for their money.

The *Xerox Presents* package includes a runtime version of *Windows* 2.1, Bitstream fonts

(continued on next page)

Xerox Presents *focuses its strongest features on producing appealing charts and integrating those charts into on-screen presentations.*

HANDS-ON INDEX

GEM ARTLINE
Prints professional-quality, object-oriented graphics .. 36

LASER-READY
Fill-in-the-blanks business forms for the HP LaserJet . 36

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Fast-running, standalone worksheets in C 43

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Lets old applications drive HP LaserJet, DeskJet..... 36

XYWRITE III PLUS
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PREVIEW
Streamlines CADD drawing review, annotation 56

XEROX PRESENTS

(continued from page 33)

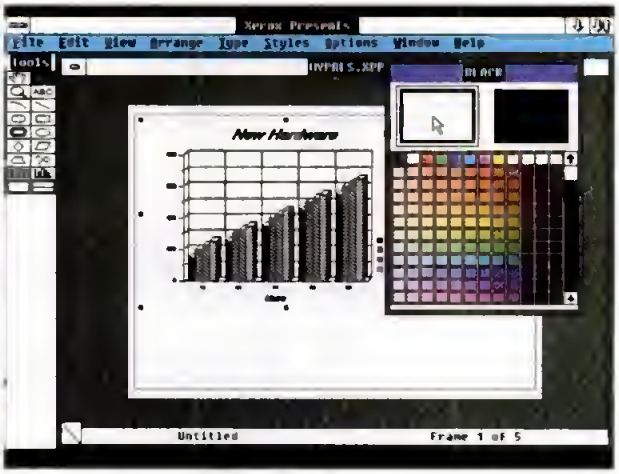
for the HP LaserJet, a daunting reference manual, a more-accessible training guide, plentiful clip art, and sample presentations to get you started.

Windows users will feel right at home with *Xerox Presents*, and first-time *Windows* users should have little trouble. The main screen includes an object-oriented toolbox for selecting boxes, lines, text, charts, or graphs. Once selected, you can double-click on the object to set attributes like typefaces, type size, line style, line weight, foreground and background colors, and so on.

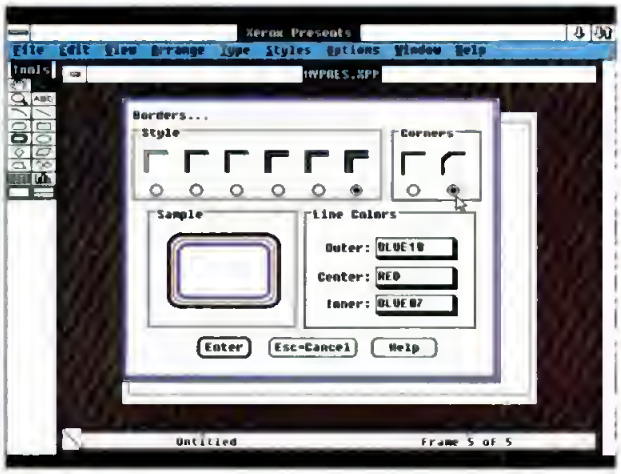
Some objects have more options than others, and these can be real time-savers. For example, the border object lets you select two or three rule borders, each with variations on thick and thin lines, as well as corner styles.

Presents handles color very well. Every object can have a foreground and background setting as well as fill colors. You select colors from a chart that displays all available values based on your display adapter. With VGA you get an impressive palette with scroll bars. EGA users get to see only the closest primary (if you're still hanging on to your old EGA, give up).

Charts are the mainstay of most business presentation graphics, and *Xerox Presents* holds its own nicely here. You can enter data in a table or import it from text or from a *Lotus 1-2-3* worksheet (curiously, *Microsoft Excel* data import is not supported). The chart object lets you select several chart types (scatter, line, area, pie, column, and bar) and offers visual 3-D effects, but no support for a third axis. Plotted charts can be sized to fit, and you can add colors and patterns for emphasis.



Xerox Presents *lets you define a background color, foreground color, and fill pattern and color for each graphic object.*



You can choose from among several border and corner styles via the border attributes menu. Xerox Presents *lets you define the color of each border line.*

Xerox Presents also supports a table object, or text chart. Instead of trying to graft textual matter onto a data-oriented chart, you can select a table with variable column widths and enter text directly.

Import is not limited to text and data. *Xerox Presents* lets you import TIFF files and bitmaps from *Publisher's Paintbrush* and *Windows Paint*, metafile output from *Freelance*, and EPS (encapsulated PostScript) output from Adobe's *Illustrator* or Aldus's *FreeHand*.

Xerox Presents is heavily oriented toward presentations. Instead of creating one file per image, *Xerox Presents* lets you store an entire presentation. You can shuffle images as needed and continue to rearrange your presentation until you're satisfied. Once you have the order, *Xerox Presents* uses the same set of images to create Handouts and Notes.

The Handouts option lets you place from one to six images on each page. It then prints a handout, automatically inserting dates and page numbers according to page styles. The Notes option prints a smaller version of each image with enough room for the presenter's notes. Both features are a real boon, even for a small presentation.

Xerox Presents also lets you display presentations on-screen and offers a wide variety of dissolves, speeds, and timing options. I would highly recommend a VGA or 8514 graphics adapter, a fast AT, and ample memory, but otherwise the on-screen presentations are very well done.

There are some problems with *Xerox Presents*, one in particular that may hold back people who produce the presentations. *Xerox Presents* currently offers no drivers or support for commercial film recorders like Polaroid Palette or Matrix QCR. If you want color slides or transparencies, you must send them out to Autographix. No exceptions.

Xerox has an Autographix driver and a special arrangement with the company. You can send files or use a built-in communications program to upload presentations (Xerox includes all the information you need to sign up). For many people, particularly those with a limited number of presentations, the Autographix route is best. But if you've invested in film recorders or color printers, you're going to have to look elsewhere for now.

The other oddity is the total lack of alternative output file formats. Since Handouts and Notes are built into the software, this is not devastating and you can use *Windows*' Clipboard to move images, but some other format—EPS comes to mind—would be helpful for exporting presentations into other applications.

If these two impediments mean nothing to you, then you'll be delighted with *Xerox Presents*. For generating on-screen presentations and internal handouts, *Presents* holds its own against the best. PC

FACT FILE

Xerox Presents,
Version 1.0
Xerox Corp.
9745 Businesspark Ave.
San Diego, CA 92131
(800) 992-2382
List Price: $495
Requires: 640K RAM (1MB recommended), *Microsoft Windows*-compatible graphics display and adapter, hard disk, DOS 3.1 or later.
In Short: Excellent object-oriented graphics interface and powerful presentation features burdened by a lack of film-recorder support and a scant range of output file formats. Not copy protected.

CIRCLE 453 ON READER SERVICE CARD

IBM LAN

(continued from page 33)

The major difference between IBM's *LAN Server* and its *LAN Manager* cousins is the integration of the LAN requester with a communications manager and database manager in OS/2 Extended Edition 1.1 The programming interfaces and dynamic linking libraries available for these programs—enhanced by the glow of the IBM logo—are alluring to system developers.

Will developers take the bait and write successful network applications unique to IBM's OS/2 Extended Edition? That remains to be seen, but if you are a potential LAN buyer or a system integrator, you need to consider the possible explosive growth of IBM's uniquely integrated version of OS/2.

There are some minor differences between *LAN Server* and generic *LAN Manager* in the areas of security and command interfaces. IBM operates its networks under a principle of "domains." One server in each domain controls all security access for all other servers in the domain. For most people the differences in this security system and the centralized log-in server option available under *LAN Manager* is very small. The administrator of a mixed *LAN Server/LAN Manager* network will have to juggle the two different security systems, but the results are invisible to the user.

Under generic *LAN Manager*, you can perform all network functions via the command line or via the Presentation Manager (PM) interface. Under IBM's *LAN Server*, you can execute only certain network commands via the Presentation Manager. This detracts from the "invisibility" of the network and burns more RAM, but it enhances the visibility of the PM for IBM.

The major strategic differences between *LAN Server* and *NetWare* are now the same as the differences in marketing strategy between IBM and its competitors in the mainframe market. IBM is trying to capture customers, and Novell is trying to be all things to all people. But in this case, IBM is starting from the underdog position in the market.

The integration of database and communications software engines into OS/2 Extended Edition is a strategic move on IBM's part. However, Novell offers via coupon its Message Handling System with every copy of *NetWare*, and the *NetWare* SQL database product started shipping last December. Both of these "network engine" products already have a good base of support.

Novell's tactic of serving the world is more than a promise. Macintosh computers are now nicely integrated into *NetWare*, Version 2.15, and *NetWare* for the DEC VAX has been shipping for months.

On the technical side, *LAN Server* requires servers with IBM hardware and a lot of RAM. *NetWare* runs on a wide variety of machines and needs about 2MB of RAM to run well. Both products are responsive enough to carry dozens of active stations, but we tip our hat to *NetWare* for all-out speed.

OS/2 LAN Server is an important strategic product for IBM. Intrinsic in the combination of *LAN Server* and OS/2 Extended Edition is the capability to fight off the clones and to capture new sales. It will be interesting to see if the applications that follow make use of IBM's unique OS/2 Extended Edition capabilities. PC

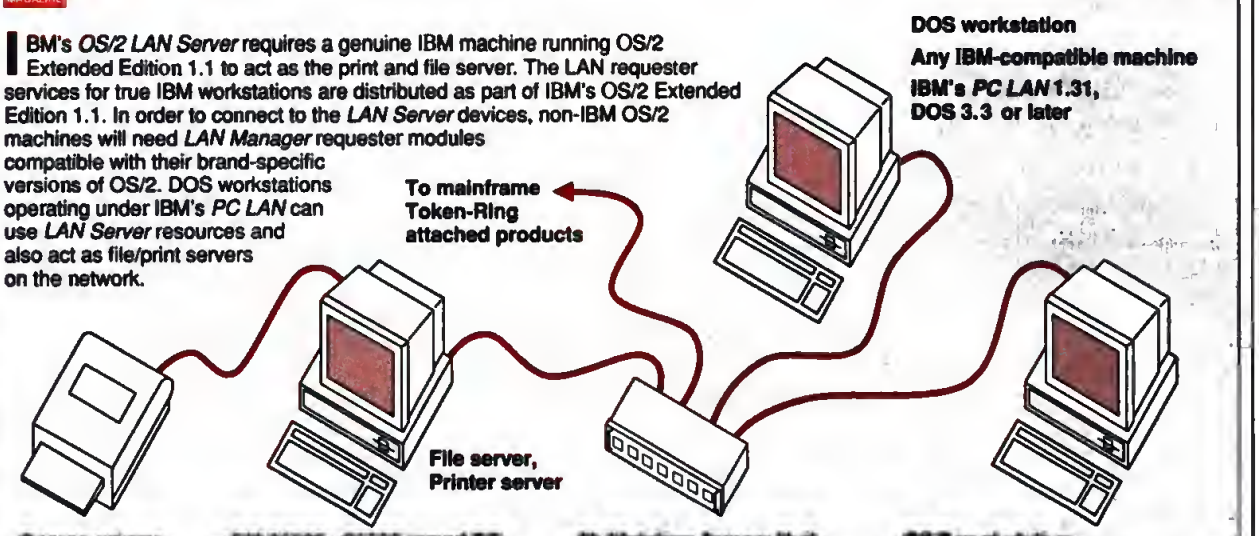
PC MAGAZINE FACT FILE

OS/2 LAN Server
IBM Corp.
Contact authorized IBM dealer or phone (800) IBM-2468
List Price: $1,040; IBM's OS/2 Extended Edition 1.1, $795.
Requires: Network server: 4MB RAM, *OS/2 LAN Server*, IBM's OS/2 Extended Edition 1.1, true IBM PC AT or PS/2 80286- or 80386-based system. IBM's OS/2 Extended Edition workstations: 3MB RAM, true IBM 80286- or 80386-based system. DOS workstations: 640K RAM, IBM's *PC LAN*, Version 1.31, IBM PC/AT/XT or compatible system, DOS 3.1 or later.
In Short: IBM's implementation of Microsoft's *LAN Manager*. Offers the advantages of integration with IBM's communications and database managers, but it ties users to IBM hardware for network server and OS/2 Extended Edition workstations. Not copy protected.

CIRCLE 456 ON READER SERVICE CARD

PC MAGAZINE IBM's OS/2 LAN Server

IBM's *OS/2 LAN Server* requires a genuine IBM machine running OS/2 Extended Edition 1.1 to act as the print and file server. The LAN requester services for true IBM workstations are distributed as part of IBM's OS/2 Extended Edition 1.1. In order to connect to the *LAN Server* devices, non-IBM OS/2 machines will need *LAN Manager* requester modules compatible with their brand-specific versions of OS/2. DOS workstations operating under IBM's *PC LAN* can use *LAN Server* resources and also act as file/print servers on the network.



Laser Control Lets Old Software Drive the Hewlett-Packard LaserJet, DeskJet

PC HANDS ON

BY EDWARD MENDELSON

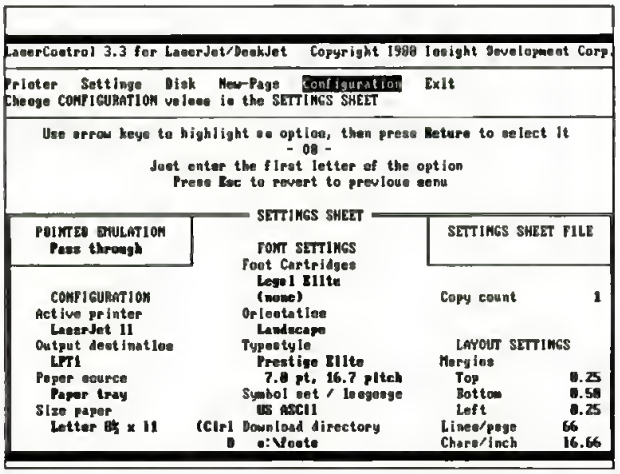
Application programs written before the HP LaserJet era tend to treat the laser printer like an overgrown typewriter. Insight Development's $149 *Laser Control* shoehorns itself between your application and your printer, letting you use the advanced graphics and typographic features of a the HP LaserJet, DeskJet, or compatible. The program is up-to-date enough to control even the double-side printing features of Hewlett-Packard's new LaserJet Series IID.

Most users will be better off getting new versions of their applications instead of spending cash, setup time, and up to 115K of precious RAM on *Laser Control*. But if you use *Lotus 1-2-3* or *Symphony*—especially older versions that can't print high-density graphics on the LaserJet—*Laser Control* offers worthwhile features and flexibility.

Instead of having to copy baffling printer control codes into *1-2-3*, you simply pop up *Laser Control*, select the smallest available landscape font, and watch *1-2-3* print an enormous spreadsheet on a single page.

Laser Control can translate Epson graphics to LaserJet graphics on the fly, a feature you'll appreciate if your version of *1-2-3* can print high-density graphics on a dot matrix printer but not on a LaserJet. *Laser Control* can even compensate for flaws in some of *1-2-3*'s graphics routines.

A full set of graphics options lets you take the Epson or IBM graphics output of any program, adjust its size and density, and print it at any position on the page. If you have time to spare, you can use this option to add a graph to a page that already contains printed text.



Laser Control *uses Lotus-style menus to select page layouts and printer commands.*

Laser Control includes a few dozen other printer control functions, but most can be done more effectively by smaller, less-expensive programs, and some aren't worth doing at all. For example, you can use *Laser Control* to take monospaced output from older word processors and print it in proportional type. But after hours of fine-tuning, the result won't approach the quality you'd get from programs that drive the LaserJet directly. You can also use *Laser Control* as a font downloader, but smaller, dedicated programs do the job just as well.

PC MAGAZINE FACT FILE

Laser Control
Insight Development Corp.
1024 Country Club Dr.
Moraga, CA 94556
(415) 376-9500
List Price: $149
Requires: 115K free RAM; Hewlett-Packard LaserJet, DeskJet, or compatible, DOS 2.0 or later. Not copy protected.

CIRCLE 449 ON READER SERVICE CARD

XyMouse: Mouse Menus for XyWrite

PC HANDS ON

BY EDWARD MENDELSON

XyQuest's latest *XyWrite* update includes a new menuing system geared for new and occasional users (see "XyWrite Adds Point-and-Shoot Menus," page 54). If you feel more at home navigating via mouse than cursor keys, however, Galactic Software's *XyMouse* may be your cure of choice for the *XyWrite* command-line blues.

This $149 mouse menu lets you click your way to virtually all of *XyWrite*'s functions, from calling a file or underlining text to redlining and setting up column tables. Among its unusual features is a "keyboard simulator" that lets handicapped users enter letters or common words by moving the mouse small distances around a keyboard map in a corner of the screen.

XyMouse is one of the most elaborate mouse menus ever written. It knows enough to speed up the mouse when you call up *XyWrite*'s help screens so you can reach the topic you need at top speed. The program modifies your *XyWrite* startup and keyboard files, adds 150K of help files to *XyWrite*'s already substantial help screens, and fills almost 40K of RAM. With a two-button mouse, *XyMouse* gives you improved cursor control. A three-button mouse adds elaborate control over defined blocks.

Beginners and unsophisticated users will find that *XyMouse* can alleviate many of *XyWrite*'s notorious terrors. Advanced users, especially those who modify *XyWrite*'s defaults, will be more disappointed. Some of the menu selections won't work at all in nonstandard setups, and some choices will produce only a beep and an "Illegal command" message.

XyMouse users will have to learn the rules that govern which situations require menu use (like returning to *XyWrite* from DOS) and which ones forbid the use of a mouse (like spell-checking a single word).

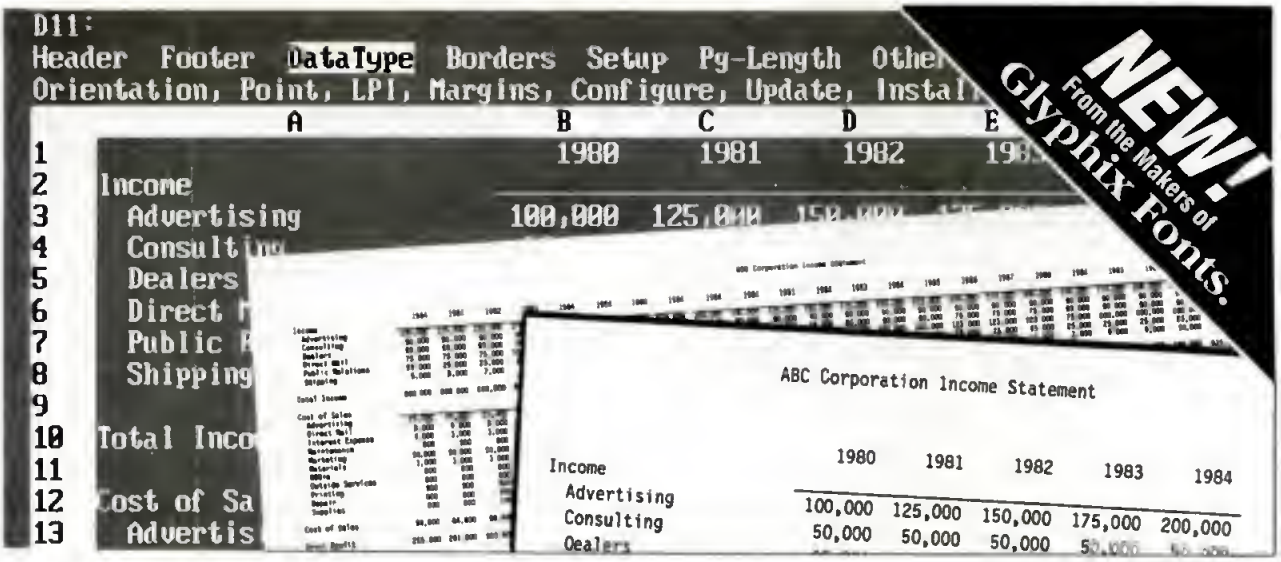
Worse still, if you want full printer control, you may have to rewrite and recompile the menu itself. If you use a Microsoft mouse, this means buying special software from Microsoft.

If you want to use a mouse for almost all *XyWrite* functions, *XyMouse* is the choice. But if a half-dozen mouse functions are all you need, XyQuest will send you a *XyWrite* mouse menu for nothing.

PC MAGAZINE FACT FILE

XyMouse
Galactic Software Inc.
2600 Philmont Ave., #211
Huntingdon Valley, PA 19006
(215) 947-0930
List Price: $149
Requires: *XyWrite* 3.52 or later; either Microsoft, Logitech, or Genius mouse. Not copy protected.

CIRCLE 451 ON READER SERVICE CARD

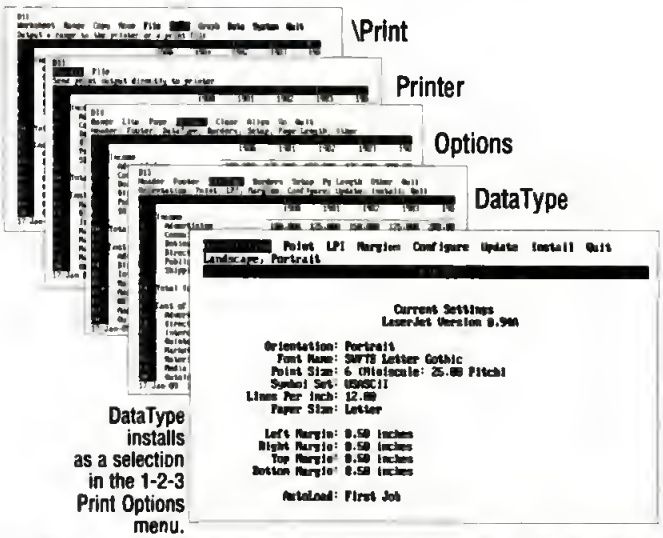


LaserJet Font Power in 1-2-3.

Print perfect spreadsheets on your LaserJet® with DataType, the new type selection Add-In for 1-2-3.†

Select the orientation, type size, lines per inch and the margins you want from the DataType menu...Align and Go!

DataType makes it easy to condense a large spreadsheet and print it sideways, or enlarge and print a range for use as an overhead. And DataType doesn't get in your way. You still set headers, footers, borders and other selections directly from the 1-2-3 Print Options menu.



DataType installs as a selection in the 1-2-3 Print Options menu.

Introducing DataType™

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- **AUTOMATIC PRINTER SET-UP.** No more set-up strings or macros to copy from spreadsheet to spreadsheet. DataType handles printer set-up and downloading automatically. You simply select the range to print, Align and Go.
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- **IDEAL FOR NETWORKS & SHARED PRINTERS!** A shared printer will be set with your font and your margins each time you print, even it another user has changed all the printer settings.
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† DataType is licensed one per printer. Multiple users may use DataType on a single shared printer.

Microsoft CD Duo Offers Economic Statistics, Small-Business Counsel

PC HANDS ON

BY LORI GRUNIN

When you're ready to trade long hours in the library for shorter hours in front of a computer, you're ready for the age of online research. Microsoft's latest CD-ROM offerings, the $125 *Stat Pack* and the $149 *Small Business Consultant*, are geared to people who need quick reference to economic data and entrepreneurial advice.

Stat Pack comprises the full text and tables of five federal-government publications: *The Statistical Abstract of the United States 1987*, *Public Land Statistics*, *Survey of Current Business*, *Area Wage Surveys*, and *Agricultural Statistics*. Every table comes in both .WK1 and .XLS formats for easy importation into your spreadsheet program.

Since these documents take up only a fraction of the space on the CD, the International Monetary Fund's (IMF's) *International Financial Statistics* would have been a welcome addition.

Small Business Consultant consists of hundreds of documents, covering numerous aspects of starting, running, and expanding a small business, issued by the Small Business Administration (SBA) and other government agencies. For balance, you'll also find a bit of private-sector advice from the accounting firm of Deloitte Haskins & Sells.

The information is broken down into categories such as Planning, Finance, and Selling, as well as one called Loss, meant to help prevent losses and criminal infractions. Microsoft includes two templates (in both .WK1 and .XLS formats) to help produce monthly cash-flow projections and profit-and-loss statements.

Stat Pack and *Small Business Consultant* share the same interface. The TSR software lets you search through a document for up to three terms. You can't perform explicit Boolean searches, but once you have found an appropriate set of hits, you can filter the set to locate a specific reference. An especially handy feature enables you to place a bookmark in a spot you know you'll want to return to. You can also import data and text into your word processor via the clipboard's cut and paste features.

One frustrating limitation, especially evident in *Small Business Consultant*, is the inability to search across categories. To find everything on "pricing," for example, you'd have to perform at least three separate searches: one under each of the categories Selling, Trade, and Management.

Both packages consolidate useful information that would take you countless hours to accumulate and sift through on your own. To be useful to the serious researcher, *Stat Pack* should be sold by subscription—a usable data set usually needs to be spliced together from various issues of the source publications on an ongoing basis; it's rarely found in one volume. But for finding an occasional statistic, it sure beats trotting down to the local library. PC

PC MAGAZINE FACT FILE

Microsoft Stat Pack
Microsoft Small Business Consultant
Microsoft Corp.
16011 NE 36th Way
Redmond, WA 98073
(206) 882-8080
List Price: *Microsoft Stat Pack*, $125; *Microsoft Small Business Consultant*, $149.
Requires: 640K RAM (512K with hard disk), DOS 3.1–3.3, CD-ROM drive with Microsoft's MS-DOS CD-ROM Extensions.

CIRCLE 441 ON READER SERVICE CARD

FeedThru Modem Gives What It Takes

PC HANDS ON

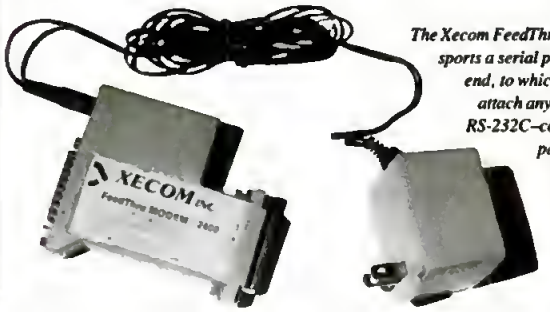
BY JONATHAN MATZKIN

My Manhattan apartment and my PC's expansion bus have one thing in common: a shortage of places to put things. So whether I'm contemplating a new couch or a new modem, I have to think carefully before I plunk down my money.

The Xecom FeedThru modem does little to expand my living quarters, but this faintly Rube Goldbergish device has allowed me to communicate without sacrificing an expansion slot or serial port.

One end of the 1- by 3¼- by 4-inch (HWD) FeedThru attaches to your serial port in much the same way that Touchbase Systems' Worldport or Migent's Pocket Modem does. But at the other end, the FeedThru has another connector, which turns out to be a serial port. You toggle between the port and the modem with a switch mounted on the case of the FeedThru. That means you can't simultaneously use the modem and whatever device you connect to the serial port. There is no way to make the switch in software. Power comes from an AC adapter.

Xecom eliminates a potential annoyance by including a serial extension cord. This allows you to place the FeedThru next to or on top of your system unit, like any other external modem, so manually switching between the RS-232 port and the modem is less irksome than it would be if you had to grope around on the back of your system unit.



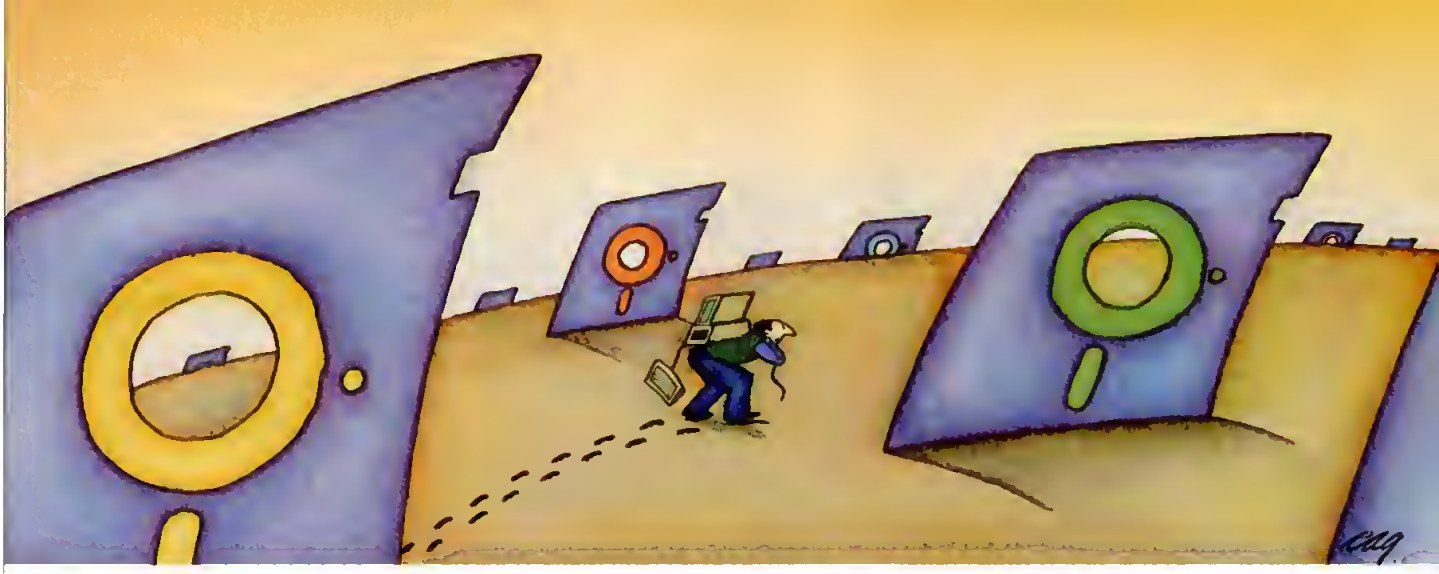
The Xecom FeedThru modem sports a serial port at one end, to which you can attach any standard RS-232C–compatible peripheral.

Photograph: Thom O'Connor

The modem half of the FeedThru lacks some of the creature comforts many of us expect, like a speaker and status lights. It is a fully functional 2,400-bit-per-second modem, however, and it worked without flaw during testing.

The FeedThru comes with *Mirror II* communications software and costs $349. For $499, you also get a serial mouse, *TurboCAD*, and *Dr. Halo III*. It's a surprisingly successful solution to your PC's housing shortage.
List Price: Xecom FeedThru, $349; with serial mouse, *TurboCAD*, and *Dr. Halo III*, $499. **Requires:** Serial port.
Xecom Inc., 374 Turquoise St., Milpitas, CA 95035; (408) 945-6640.

CIRCLE 448 ON READER SERVICE CARD



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Software Carousel is the amazingly easy way to switch almost instantly from WordPerfect to 1-2-3 to dBASE to DOS to whatever else you want. Or go from one file to another in the same program. All without saving or retrieving – or wasting a precious moment of your time. Or your computer's memory.

It works by creating a number of independent software slots to load your programs into. You get up to ten of these software slots, so you can load up to ten programs.

Need to crunch numbers? Hit a key and there's your spreadsheet. Need your word processor? Don't bother saving your spreadsheet file. Just whip over to your document and do your work. Snap back to your spreadsheet and it's just like you left it. It's like all your programs are "pop-ups," just a hotkey away.

Or load the same program into a few different slots, each with a different file. Now go from one to another in an instant.

Here's the best part of all.

You may have heard about some other "environment" programs that claim to do something similar to Software Carousel. But there are several important differences.

First, they make you split your memory up among the programs you want to use. Software Carousel lets you use all available memory in each and every program. It even supports expanded and extended memory.

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–Ralph Evans, Attorney, Fullerton, CA

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–Colin Ralph, Ralph & Panzer, Inc., Seattle, WA

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–Larry Pearsal, Rolling Hills Covenant Church, Rolling Hills Estates, CA

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–Walter Affourtit, West Islip, NY

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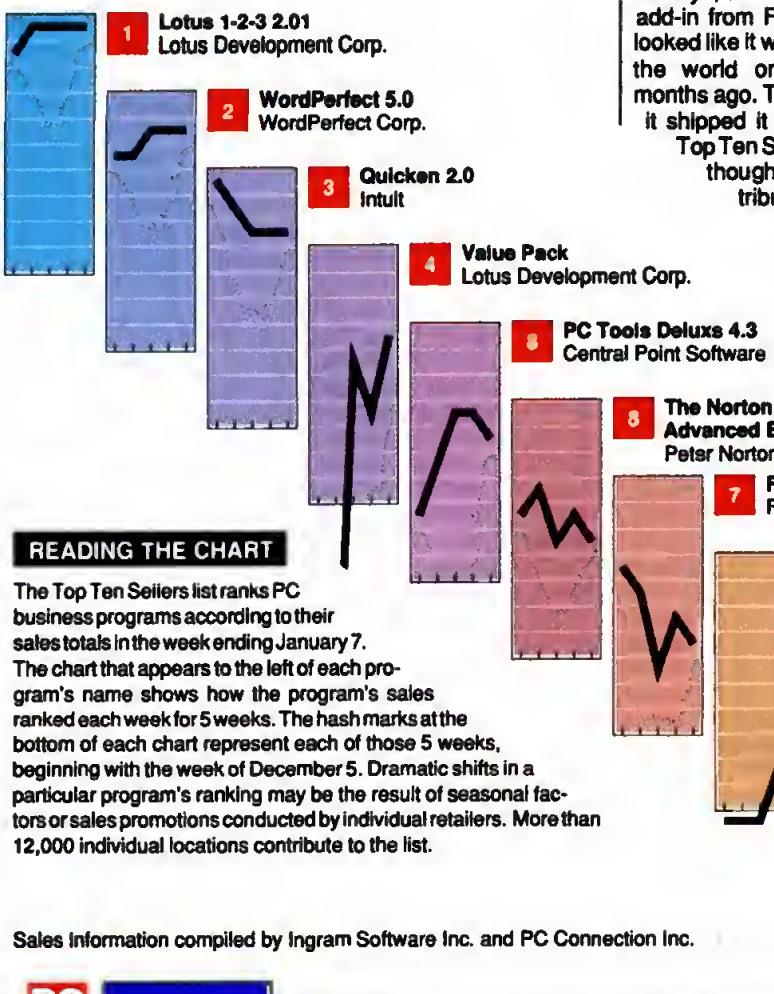
CIRCLE 334 ON READER SERVICE CARD

PC MAGAZINE PIPELINE

TOP TEN SELLERS — A 5-Week History



1 **Lotus 1-2-3 2.01**
Lotus Development Corp.

2 **WordPerfect 5.0**
WordPerfect Corp.

3 **Quicken 2.0**
Intuit

4 **Value Pack**
Lotus Development Corp.

5 **PC Tools Deluxe 4.3**
Central Point Software

6 **The Norton Utilities Advanced Edition 4.5**
Peter Norton Computing

7 **Fastback Plus 2.01**
Fifth Generation Systems Inc.

8 **Sideways 3.2**
Funk Software Inc.

9 **Microsoft Word 4.0**
Microsoft Corp.

10 **dBase IV 1.0**
Ashton-Tate Corp.

Rankings are based on net sales by unit; returns are subtracted from gross sales.

Sales information compiled by Ingram Software Inc. and PC Connection Inc.

Allways, the hot *Lotus 1-2-3* add-in from Funk Software, looked like it was going to set the world on fire several months ago. The same week it shipped it broke into the Top Ten Sellers list, even though Lotus is distributing it free with every copy of *1-2-3*.

Sales of *Allways* leveled off once the retail sales pipeline was filled in December, but surprisingly, sales of Funk's *Sideways* have come back strong. *Allways* is a superior product for those who own a laser printer, since *Allways* does far more than print spreadsheets vertically (see review on page 33, January 31,1989), but the less costly *Sideways* appeals to those who use dot matrix printers, and it is on many corporate "approved for purchase" lists, an honor that will guarantee steady sales for a long time.

READING THE CHART

The Top Ten Sellers list ranks PC business programs according to their sales totals in the week ending January 7. The chart that appears to the left of each program's name shows how the program's sales ranked each week for 5 weeks. The hash marks at the bottom of each chart represent each of those 5 weeks, beginning with the week of December 5. Dramatic shifts in a particular program's ranking may be the result of seasonal factors or sales promotions conducted by individual retailers. More than 12,000 individual locations contribute to the list.

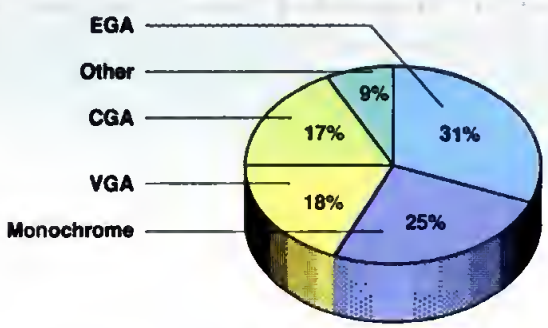
PC MAGNET SURVEY

When it comes to video and a PC processor, the choice is almost always budget-dependent. Yet, the more expensive choices seem to be clear winners with callers to PC MagNet, *PC Magazine*'s on-line service.

More than 1,200 callers answered this survey, which polled them on their current video display, current processor, and plans for future PC processors.

In the third question, respondents could select more than one "plan to buy" system; surprisingly, the 286 and 386 systems tied.

What type of display do you use?



WILL THE WORLD BECOME OBJECT ORIENTED?

Work with computers often involves breaking big things down into smaller parts: databases divide groups of information into records and fields, and then make you go through a series of procedures to look at the data. It's the kind of hair-splitting detail that makes training so difficult.

One of today's emerging trends is a class of software that works at a higher level, dealing with information in groups. Called object-oriented programming languages (OOPLs), they divide a full program into modules and deal with bits of data as classes, making interrelationships among objects far easier to achieve.

In traditional, procedural programs, data and functions are separate; functions act upon data and produce new data. In an OOPL, an object includes data and functions, creating program modules that are more independent from the overall program structure.

Applications written in object-oriented programming languages tend to provide vehicles with which you can manipulate data, overcoming the more restrictive nature of programs that force you to define your terms at every turn and deal with data in procedures.

One example is the difference that exists between *1-2-3* and *Microsoft Excel*. In a *1-2-3* spreadsheet, you begin an operation, like printing, then select a range, and define all aspects of the print job; every single task is procedural. When you press the Slash key, you begin menu operations. Move the cursor and you're in point mode.

> One of today's emerging trends is a class of software that works at a higher level, dealing with information in groups.

In *Excel*'s object-oriented environment, you select an area (the object), and then select an operation to be performed on it. You highlight a range of cells and then choose a new font. Or, you decide that this range of cells should be displayed as a database form and select that operation. The worksheet itself is an object that you can move into a window or link to another worksheet.

But *Excel*'s only a first step toward object-oriented applications. *Wingz*, an integrated program that will soon be sold for the Mac and later will appear on the PC under OS/2, takes the concept further. In *Wingz* a graphic could occupy the cell next to a worksheet formula; both are objects even though each belongs to a different data class and therefore behaves differently.

The changes that OOPLs will bring to PCs are profound. Even the highly procedural *dBASE* language will probably evolve into an object-oriented database in which pictures can be easily linked to words and numbers.

A *Microsoft Windows* application being developed by Asymetrix (which was founded by Bill Gates's early partner at Microsoft, Paul Allen) will soon make OOPL techniques accessible to the casual user in building his own applications.

And Mitch Kapor, one of *1-2-3*'s architects, is spearheading a new venture, ON Technology, that is creating an object-oriented platform for applications to use for system services.

One of the most important tools in this evolution is C++, an object-oriented extension of C that was developed at AT&T's fertile Bell Labs. Microsoft is now working on a C++ extension to its C compiler that will probably be called C-Sharp.

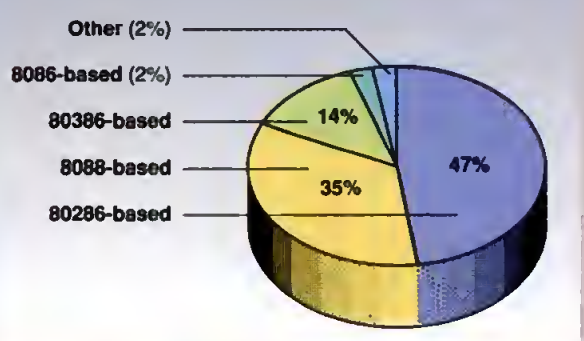
OOPL developers are excited by the potential help they can get from a new C++ tool kit called *CommonView* from the Scottish firm Glockenspiel. Its libraries offer the class definitions and dynamic link modules needed to build applications that will run in *Windows*, OS/2, X Windows, and on a Mac.

The ability to move applications to different computing environments will become more important to developers as they see the potential to get a higher payback on their investment in the original code. OOPLs are a good foundation for that kind of program development.

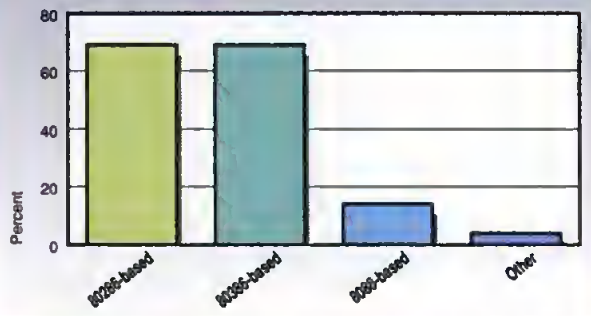
Signposts

If you've got a fax machine, get ready for junk fax. Entrepreneurs are starting to build databases that tie in to PC fax boards for mass mailings. The databases come with a shell and drivers to specific fax boards, so that the difference between faxing one or 100 faxes is just a menu choice. Digital Publications of Norcross, Georgia, is marketing one of the first; it ties in to Quadram's JT-Fax. —**Gus Venditto**

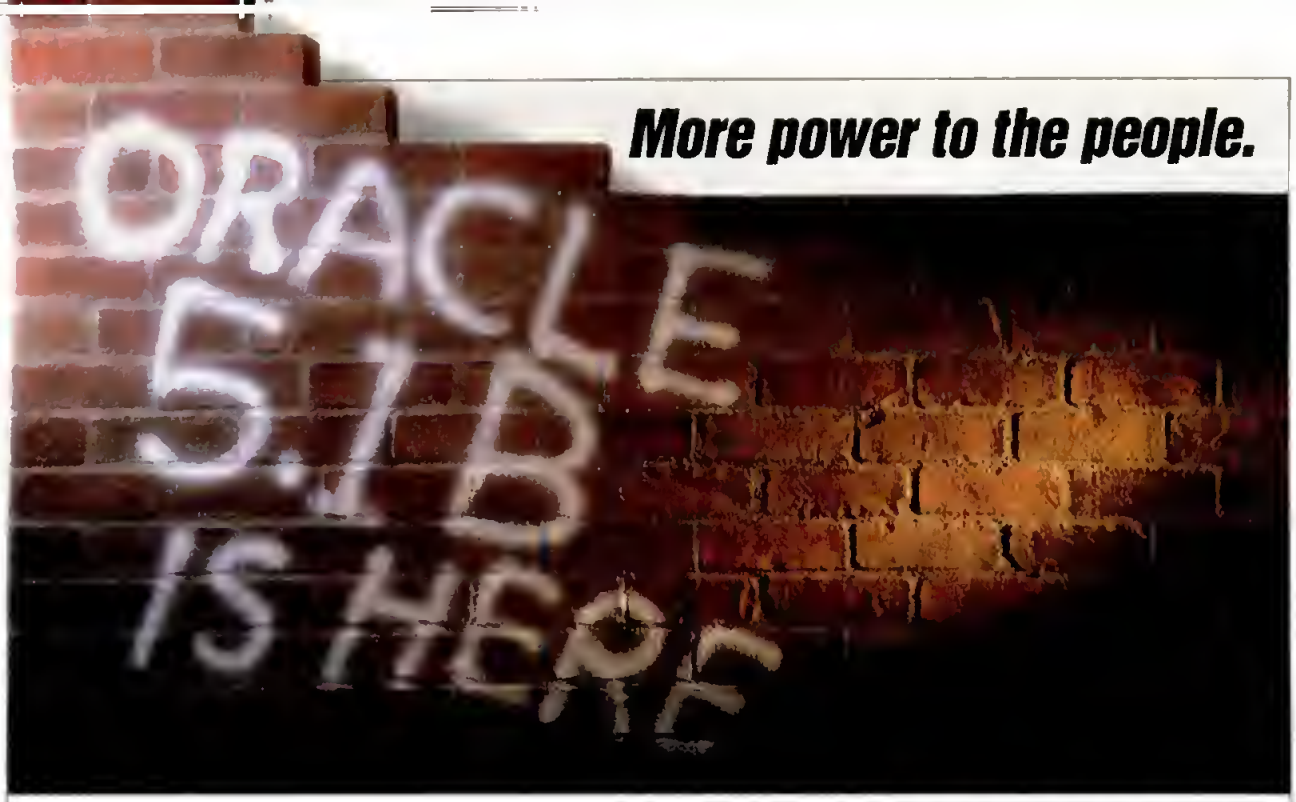
What type of PC do you use?



Which types of PCs does your company plan to buy in the next year?



More power to the people.



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PC MAGAZINE EDITORS' CHOICE May 17, 1988

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Compile 1-to-C Generates Fast-Running, Standalone Worksheets in Microsoft C

PC HANDS ON

BY RICHARD HALE SHAW

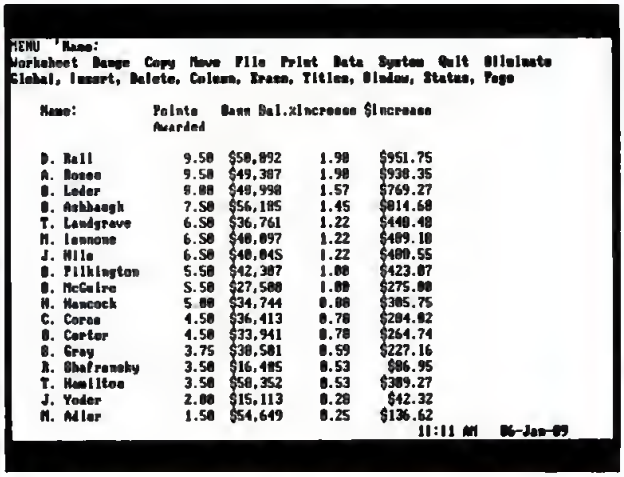
People who compose worksheets for others to use are always looking for something more. Some look for faster recalculations, a way to hide and protect formulas and macros, or a means of reducing memory overhead. Others need a way for a worksheet to be run by users who don't own a spreadsheet program. *Compile 1-to-C*, a spreadsheet compiler from Resource Analysis International, gives you all this and then some.

Compile 1-to-C converts a worksheet to C and compiles the generated C programs into a file that can be run with *Compile 1-to-C*'s runtime program. You don't have to know anything about programming to convert a worksheet, and a worksheet user will have to know only a little about spreadsheets to use the compiled worksheet. Regardless of which spreadsheet you used to create it, you can convert nearly any worksheet as long as it is stored in a .WKS or .WK1 file.

Compile 1-to-C will also dramatically cut the time required for worksheet recalculations. During testing of *Compile 1-to-C*, the compiled version of the PC Labs Spreadsheet Test recalculated in two-thirds of the time needed by *Lotus 1-2-3*, and less-complex worksheets show even more improvement. In case you need all the performance you can get, *Compile 1-to-C* can take advantage of a math coprocessor and can use up to 64K of expanded memory.

The package includes a well-organized pocket-size manual and four disks. Everything you'll need to compile worksheets is provided, including a special version of Microsoft C and the *Compile 1-to-C* runtime program.

You can begin to use *Compile 1-to-C* immediately after installation, by selecting the Compile Worksheet menu. The program will transparently convert the worksheet to C and run the C compiler. When it's finished, *Compile 1-to-C* will return you to DOS with instructions for running the worksheet. To run the compiled worksheet, you enter the name of the *Compile 1-to-C* runtime program, 12CRUN, followed by the name of the worksheet. You'll find that the behavior of the compiled worksheet is nearly identical to that of its *1-2-3* counterpart.



Compile 1-to-C *lets you convert nearly any .WK1 or .WKS worksheet into a standalone version. The column and row borders can be toggled on ond off.*

Most worksheets (including the PC Labs Spreadsheet Test) will compile without modification. However, you may find it necessary to make a few changes. For example, the *1-2-3* Define command will not work properly in a compiled worksheet, and operations that edit or copy worksheet formulas or that delete or insert rows and columns must be removed or modified in the original worksheet first. The manual clearly lists macros and commands that are not supported.

Compile 1-to-C provides a utility that lets you check the accuracy of its interpretation of the macros and formulas in your original worksheet. You can modify macros in the compiled worksheet with the on-screen macro debugger.

The package also gives you several features for customizing and protecting compiled worksheets. Any of the menu commands can be eliminated from the compiled worksheet's main menu, or the Slash (/) key can be disabled altogether. The user cannot edit formula cells. The /File Save command saves worksheet data instead of the worksheet itself. The row and column borders do not display when the worksheet is loaded, though this can be toggled back on. And lastly, you can configure the printer control strings and worksheet colors.

Compile 1-to-C is not copy protected. However, the personal version limits distribution of the runtime program to ten copies; the corporate version has no restrictions.

All in all, *Compile 1-to-C* does its job well. It's unbeatable for distributing worksheets without having to buy extra copies of your spreadsheet, and for keeping macros and formulas confidential. If you're a spreadsheet author, then *Compile 1-to-C* is the "must-have" tool you've been looking for. PC

The Compile 1-to-C *printer setup menu allows you to specify printer setup strings and set page size and margins.*

PC MAGAZINE FACT FILE

***Compile 1-to-C*, Version 1.5a**
Resource Analysis International
12581 Venice Blvd.
Los Angeles, CA 90066
(213) 390-7661
(800) 877-6788
List Price: Corporate version, $899; personal version, $299; upgrade to corporate version within 60 days of purchase, $600.
Requires: 215K RAM (640K RAM suggested), hard disk, DOS 2.0 or later.
In Short: A spreadsheet compiler that converts worksheets created with most major spreadsheets into C and compiles them into standalone programs. Highly recommended for spreadsheet authors. Not copy protected.

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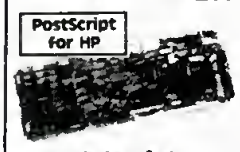

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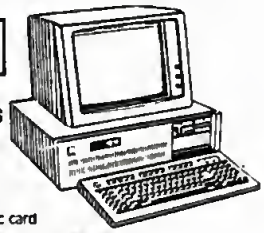

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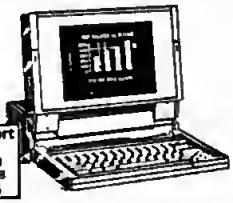

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CIRCLE 254 ON READER SERVICE CARD

$90 Laser-Ready: The Mindless Route to Good-Looking LaserJet Documents

PC HANDS ON

BY EDWARD MENDELSON

Laser-Ready, Mind Path Technologies' $89.95 LaserJet printing program, creates consistently good-looking documents using soft fonts that come in the package. Unfortunately, it makes you walk through rigid and seemingly endless menus every time you write and print.

To write a letter, you fill in the blanks in a long series of menus. One blank field lets you type the text of the letter itself, using *Laser-Ready*'s primitive word processor. When you're through, your LaserJet prints a letter in proportional type, with the date, greeting, salutation, and closing all in the right places. At the top is your name and address in a different font, laid out in your choice of three letterhead formats. Press a function key and you can print an envelope with the same letterhead format for the return address.

Another series of menus lets you fill in the blanks to create resumes, flyers, newsletters, invoices, and purchase orders in various preset formats. Still more menus let you print sheets of mailing labels or business cards—the manual doesn't explain how to put a *sheet* of business cards through the LaserJet's paper slots.

Many of the menus offer options for custom formats; but don't get your hopes up: when you choose the custom option, you merely get a notice that the vendor will sell you a version of the program with your custom letterhead built in.

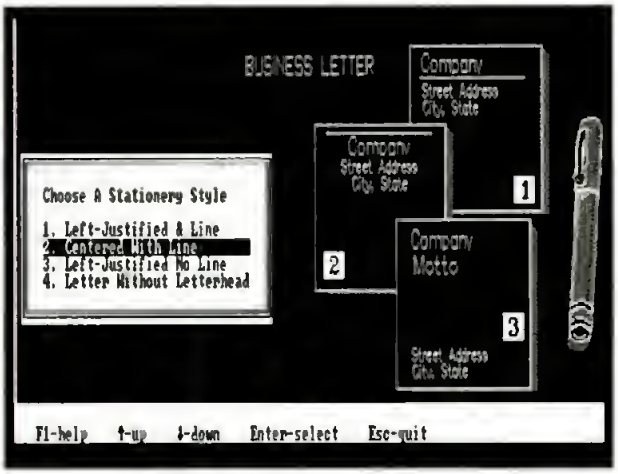
Laser-Ready can print spreadsheets that you've already printed to a disk file from within a spreadsheet program. It can also print pure ASCII text files. The program can't give you the format options of even the simplest word processors, but at least you don't pay extra for the Times Roman, Helvetica, and Prestige Elite soft fonts.

The bulkiest item in the package is a sheaf of paper samples suitable for laser printers. You get blank labels, one envelope, one sheet of transparency film, and an order form that encourages you to buy more. The second bulkiest item is a sheaf of advertisements for other laser-printer products.

Steer clear of *Laser-Ready* if you don't like cute-looking software. Many of the menus waste the right side of the screen with a picture of a fountain pen or pencil. At least they take up less space than a LaserJet.

List Price: *Laser-Ready*, $89.95.
Requires: 512K RAM; CGA graphics display, HP LaserJet or compatible, 1MB hard disk space, DOS 2.0 or later. Not copy protected. Mind Path Technologies, 12700 Park Central Dr., #1801, Dallas, TX 75251; (214) 233-9296

CIRCLE 452 ON READER SERVICE CARD



Laser-Ready *supplies a choice of preset formats for a host of documents, including letters, resumes, flyers, newsletters, invoices, and purchase orders.*

GEM Artline Generates Professional-Quality Output

PC HANDS ON

BY DONALD B. TRIVETTE

If your printed graphics look like they were drawn using a saw instead of a ruler, *GEM Artline* from Digital Research can give your drawings the hard, clean edges they deserve. *Artline* creates professional-quality illustrations and textual effects for both desktop publishing and standalone graphical design applications.

By creating object-oriented graphics defined in *x*- and *y*-coordinates, *Artline* can take advantage of the full resolution of any printing device whether it be a 9-pin dot matrix printer or a 2,480-dot-per-inch phototypesetter. Scaling up or down is a mathematical process that produces a sharpness that contrasts vividly with the more-common pixel graphics done by *PC Paintbrush* and other popular painting programs. Even on an inexpensive 9-pin dot matrix printer, the *o*'s and *s*'s look like they were laid down by a laser.

Manipulating text is where *Artline* really shines. An inherent advantage of storing text and drawings as formula, instead of as pictures, is the ease of creating special effects. Type sizes can vary from 1 to 999 points (1 point = 1/72 of an inch), and letters can be stretched, slanted, mirrored, and deformed in an infinite number of ways.

Artline runs under *GEM*, which is included with the product. *Artline* sports *GEM*'s familiar pull-down menus at the top of the screen and an assortment of tool-box icons on the left border, but the tool box badly needs an Undo tool and a better Zoom feature.

It also lacks an eraser, though this shortcoming is due more to the nature of *Artline* than to an oversight. Erasing bits of drawings is a suitable way to alter pixel drawings but not those produced by mathematical coordinates. Regardless, this contributes to making freehand sketching and painting cumbersome and frustrating. *Artline* does include a feature that lets you import and trace pixel drawings, but doing so requires extended memory and is a tedious process.

The *GEM* interface handles output superbly. You can select a variety of dot matrix, ink jet, and laser printers or you can send output directly to a PostScript printer. The software supports color for the Xerox 4020, HP PaintJet, color PostScript, and 35mm slide services. In addition *Artline* exports files directly to Xerox's *Ventura Publisher*, Aldus's *PageMaker*, and its own *GEM Desktop Publisher*.

GEM Artline is fast, and its clean, crisp output is professional quality. For any type of textual design or effect, this type of object-oriented graphics is the way to go. PC

List Price: *GEM Artline*, $495.
Requires: 640K RAM (512K expanded memory needed for image tracing), hard disk, EGA or VGA monitor (mouse recommended), DOS 2.0 or later. Not copy protected. Digital Research Inc., 70 Garden Ct., P.O. Box DRI, Monterey, CA 93942; (800) 443-4200.

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PC-Globe Plus: Maps and Facts

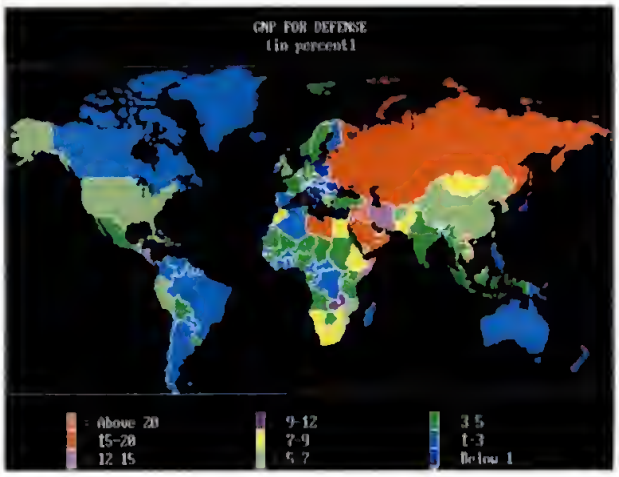
PC HANDS ON

BY BARRY SIMON

PC-Globe put maps and related geographical facts at your fingertips. Now, *PC-Globe Plus* adds more data and support for more output devices. At $69, *PC-Globe Plus* is priced low enough for home use. And, for business use, detailed maps and large databases of geographic, economic, and demographic information make this lovely on-disk atlas a sophisticated reference tool.

PC-Globe displays a world map, on which you can locate and highlight individual countries and 18 country groupings (NATO, OPEC, and so forth). A useful feature lets you color-code the world map to show rankings in 82 categories—from GNP per capita to the number of hospital beds per 1,000 people.

Individual maps and information are available for 177 different countries. You can make the country maps show cities, elevations, or notable features. For each country, there are also four graphical displays and seven text panels with information on a multitude of topics—from age distribution to economic data.



One of the more intriguing data displays in PC-Globe Plus *shows the percentage of GNP each country spends on its military.*

PC-Globe Plus has added support for EGA, VGA, and Hercules graphics to the original product's CGA-only support. Also new is support for several printers, including the HP LaserJet (unfortunately only at 150 dots per inch), mouse support, and compatibility with the .PCX file format. Drop-down menus have also been added.

Thanks to better data compression, *PC-Globe Plus* fits into less disk space than the original version. Still, if you want the power of an on-disk atlas at your fingertips, you'll have to be willing to part with 1.4MB of open hard-disk storage.

List Price: *PC-Globe Plus*, $69; upgrade from *PC-Globe*, $20. **Requires:** 384K RAM, graphics display, DOS 2.0 or later. Not copy protected. Comwell Systems Inc., 2100 S. Rural Rd., #2, Tempe, AZ 85282; (602) 894-6866.

CIRCLE **442** ON READER SERVICE CARD

With EMS, SmartKey Uses 2K RAM

PC HANDS ON

BY BARRY SIMON

If you're fond of RAM-resident keyboard macro programs but frustrated by their RAM-gobbling nature, the latest version of *SmartKey* may be just what you need.

SmortKey, Version 5.3, is the first full-featured keyboard macro program to take up less than 30K of conventional memory. If you can spare 64K of EMS memory, the $89.95 program takes up a mere 2K of conventional memory. Without EMS, it takes up only 57K RAM—still less than most of its competitors. *Keyworks Advanced*, for instance, takes up 96K of conventional memory without EMS and 61K with 64K of EMS.

SmortKey doesn't have all the conveniences *Keyworks* and *Newkey* do. But *SmartKey* includes all the basics, including record mode, printer control, date entry, keystroke recall, and a host of resident DOS services.

While earlier versions of *SmartKey* suffered from incompatibilities with some other resident programs—like *Hot Line* and *PrintQ*—Version 5.3 appears to get along with its RAM-resident peers.

Included in the *SmortKey* package is *PCKey*, which allows you to use an enhanced keyboard (like the Omnikey/102) on a computer whose BIOS doesn't support such keyboards. But beware: *PCKey* has serious incompatibilities with programs that place keystrokes directly into the BIOS buffer.

If you're craving a keyboard macro program that won't eat up lots of RAM, *SmartKey* may be for you—especially if you've outfitted your system with at least a touch of EMS memory.

List Price: *SmartKey*, Version 5.3, $89.95; upgrade from Version 5.0 and later, $25. **Requires:** 256K RAM, DOS 2.0 or later. Not copy protected. Command Software Systems Inc., 28990 Pacific Coast Hwy., #208, Malibu, CA 90265; (213) 457-1789, (800) 423-9147.

CIRCLE **444** ON READER SERVICE CARD

Mickey: $20 Utility Adds Mouse Speed Control

PC HANDS ON

BY EDWARD MENDELSON

The worst thing about Metroplex Digital's *Mickey* is its name. The best thing about this $20 utility is that it lets you speed up or slow down your mouse, simply by pressing a hotkey. A slower mouse means better control over graphics. A faster mouse means less time wasted during text editing.

Mickey adds speed and convenience to your mouse when you're using such applications as *Ventura Publisher* and *Microsoft Word*. But *Mickey* doesn't affect the mouse in *Microsoft Windows*, which has its own speed controls.

The second best thing about *Mickey* is that it makes the right-hand mouse button emulate the Enter key. This means you can press the right button to tell *Venturo Publisher* "OK" instead of dragging the mouse over to the "OK" box.

The second worst thing about *Mickey* is the 24K that it nibbles from RAM. That's more than twice the memory required by the software that activates the mouse itself.

I like what *Mickey* does, and the price is right. Whether the added control and convenience the product provides is worth sacrificing 24K RAM is another issue.

List Price: *Mickey*, $20. **Requires:** 24K free RAM, mouse, DOS 2.0 or later. Not copy protected. Metroplex Digital Corp., P.O. Box 815729, Dallas, TX 75381-5729; (214) 231-8944.

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PC MAGAZINE EDITOR'S CHOICE September 1987

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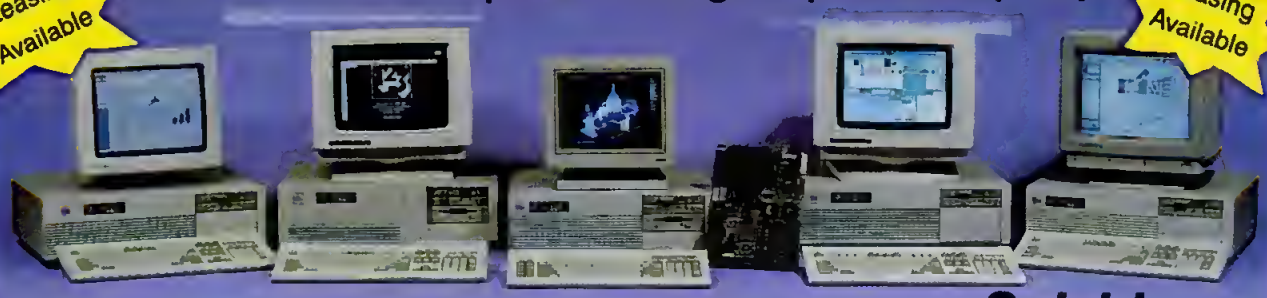

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- 101 Enhanced Keyboard
- Western Digital 2F-2H Controller.
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- AT and OS/2 Compatibility.
- 220 Watt Power Supply
- Socket for Weitek, 80387 and 80287.
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- 220 Watt Power Supply.
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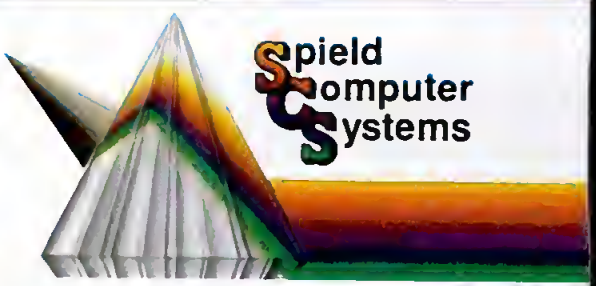

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CIRCLE 390 ON READER SERVICE CARD

NEW ON THE MARKET

by Lori Grunin

Traveling Software's ViewLink Synthesizes Your Files

Now that the computer-as-productivity-tool is ensconced in our lives, the next hurdle we face is dealing with the huge mass of information and applications stored on our hard disks.

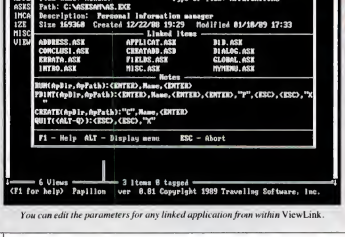
Traveling Software's solution, the $149 *ViewLink*, lets you create "views"—linked files of any format—that match a given alphanumeric search, file type, or generation date. Thus, a view lists files by content, rather than location. An automatic update feature will add a new file into a view if it satisfies specified criteria.

The program also acts as a sophisticated DOS shell, allowing you to run other applications from within it. For instance, selecting TEST.DBF from the point-and-shoot menu will cause *ViewLink* to launch *dBASE* and load the database "TEST." Alternatively, you can enter the "Applications" view and call up a dialog box of applications to run.

ViewLink recognizes many popular applications, such as *Lotus 1-2-3*, *WordPerfect*, and *PFS:First Choice*, and it will automatically generate views for each during installation. The program operates across networks and shrinks its memory overhead to 60K while running another application.

List Price: *ViewLink*, $149.
Requires: 384K RAM, hard disk recommended, DOS 2.0 or later.
Not copy protected. Traveling Software, 18702 North Creek Pkwy., Bothell, WA 98011; (206) 483-8088.

CIRCLE **432** ON READER SERVICE CARD



You can edit the parameters for any linked application from within ViewLink.

Toshiba Shrinks the CD-ROM Drive

CD-ROM is a relatively new area of computer technology, and already the push is on to create smaller drives: **Toshiba**'s newest CD-ROM drive, the XM-3201A, measures only 2½ by 8 by 9 inches (HWD) and works while vertical, as well as horizontal.

The $1,095 drive has an average access time of 400 milliseconds and reads High Sierra–formatted disks with up to 680MB of data, according to Toshiba. In addition, the XM-3201A has audio output capability. The drive comes with a SCSI interface and power supply, everything necessary to operate with a PC or compatible, PS/2, or Macintosh.

List Price: Toshiba XM-3201A, $1,095. **Requires:** DOS 3.1–3.3.

Toshiba America Inc., Disk Products Division, 9740 Irvine Blvd., Irvine, CA 92718; (714) 583-3108.

CIRCLE **437** ON READER SERVICE CARD

Sanyo Offers Small-Footprint 80386

For power users who want to keep their machine on their desk but don't want to displace the rest of their work, **Sanyo** offers

(continues on next page)

The Toshiba XM-3201A CD-ROM drive operates either vertically or horizontally.

HOT PROSPECT

Adobe Illustrator Freehand Drawing Package Comes to PC

PC users who've long envied the graphics options of their Macintosh buddies can now strut their pictorial stuff with *Adobe Illustrator*, a $695 PC version of **Adobe Systems**' acclaimed freehand drawing package. The PC version runs under *Microsoft Windows*.

In addition to on-screen sketching, users can trace scanned images and call up basic geometric shapes. They can then rotate or scale the objects, create mirror images along any axis, and shear them at any angle.

Editing features include a separate preview window, object grouping, joining or averaging multiple points, and zooming. Freehand lines can be erased before transforming them into Bezier curves, and users can specify the tolerance for freehand drawing. Users can also control text kerning and leading.

Adobe Illustrator can read files created with the Macintosh version of *Adobe Illustrator* 1.1. It can also import TIFF, .PCX, and MacPaint files as templates and .EPS files as artwork, as well as convert .DXF files.

Adobe provides a runtime version of *Windows* with the software.

List Price: *Adobe Illustrator*, $695. **Requires:** 640K RAM conventional, 256K RAM expanded (1MB to 2MB recommended); 80286-based system (80386 recommended); 20MB hard disk, 720K or 1.2MB floppy disk drive; EGA-compatible graphics adapter; DOS 3.1 or later (IBM PS/2 Models 70 and 80 require DOS 4.0 if using the runtime version of *Microsoft Windows*). Not copy protected. Adobe Systems Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039; (415) 962-2000.

CIRCLE **431** ON READER SERVICE CARD

NEW ON THE MARKET

Sanyo

(continued from page 51)

the small-footprint 80386-based MBC-18Plus. Measuring approximately 7 by 13 by 16 inches (HWD), it operates in either a vertical or horizontal position. Designed with a passive backplane, the 32-bit machine runs at a clock speed of 16 MHz with zero wait states.

The standard $3,499 configuration includes 1MB of RAM, an RS-232C, and a parallel port on the CPU board, one 1.2MB floppy disk drive, and a 101-key AT-style keyboard. Two additional half-height floppy disk drive bays, and five additional slots (three 16-bit and two 8-bit) give you room to expand.

List Price: Sanyo MBC-18Plus, $3,499. Sanyo Business Systems Co., 51 Joseph St., Moonachie, NJ 07074; (201) 440-9300.

CIRCLE **436** ON READER SERVICE CARD

The Sanyo MBC-18Plus integrates passive-backplane technology into a small-footprint unit.

Syzygy Helps Managers Bring Workgroup Tasks into Line

Information Research hopes its $395 groupware package, *Syzygy*, will help bring organization to the lives of managers by providing tools for real-time management of multiple projects, schedules, and budgets. Project information is available to every workgroup member.

The program offers managerial aids such as hierarchical activity lists, which allow you to define projects and break them down into tasks, assign tasks and set completion schedules, budgets, and priorities. *Syzygy* will also generate Gantt charts that can zoom in on individual tasks and zoom out for an overview of a project. You can create templates that automatically assign tasks and deadlines for similar projects.

Readable file formats include ASCII, .SDF (used by personal information managers such as *Agenda* and *GrandView*), .DIF, .XLS, .WK?, and SYLK.

Syzygy lets you produce over 50 reports, including status and budget reports, staff assignments and to-do lists. An SQL-based query language facilitates custom report generation.

List Price: *Syzygy*, single-user, $395; network versions range from $595 for two users to $1,995 for unlimited users per server.

Requires: 512K RAM, hard disk, DOS 3.0 or later. Not copy protected. Information Research Co., 2421 Ivy Rd., Charlottesville, VA 22901; (804) 979-8191.

CIRCLE **435** ON READER SERVICE CARD

Lotus 1-2-3 Add-ins Provide Statistical, Programming Functions

Two more additions to the deluge of *Lotus 1-2-3* add-ins expand the @ functions and programming capabilities available to spreadsheet users.

Intex Solutions' *@Stats*, a library of 44 statistical and mathematical functions, works with Lotus's *Symphony*, as well as with *1-2-3*. The $295 package includes @ functions to calculate the intercept, coefficient, and R^2 of a linear regression and to calculate skewness, kurtosis, and standard deviation of values within a range and within a distribution. Other notable functions perform linear interpolation of values within a table and integral computation.

Of course, there are always those do-it-yourselfers who like to write their own *1-2-3* functions and subroutines. **Frontline Systems'** *3-2-1 Gosub*, a $99.95 add-in, enables you to turn a column of formulas or statements into a program. The package comes with a library of @ functions that let you assign values, create loops, and branch to subprograms. You can also perform array and matrix manipulation, as well as use recursive algorithms.

List Price: *@Stats*, $295. **Requires:** 32K free RAM; *Lotus 1-2-3*, Version 2.0 or later, or *Symphony*; DOS 2.0 or later. Not copy protected. Intex Solutions Inc., 161 Highland Ave., Needham, MA 02194; (617) 449-6222.

CIRCLE **433** ON READER SERVICE CARD

List Price: *3-2-1 Gosub*, $99.95. **Requires:** 3K free RAM; *Lotus 1-2-3*, Version 2.0 or later; DOS 2.0 or later. Not copy protected. Frontline Systems, 140 University Ave., #100, Palo Alto, CA 94301; (415) 327-7297.

CIRCLE **434** ON READER SERVICE CARD

The Relisys RE1520's flat screen helps reduce glare for users of the 15-inch display.

Relisys Offers 8514/A-Compatible Multiscanning Monitor

Relisys's 15-inch RE1520 provides boundless color display at an 8514/A-compatible resolution of 1,024 by 768 pixels, according to the company. For both PS/2 and Macintosh II systems, the multiscanning monitor accepts analog signals at frequencies between 0 and 50 kHz, in both interlaced and noninterlaced modes.

In the interest of ergonomics, the $995 display incorporates a flat screen to reduce glare, as well as a cabinet that tilts and swivels.

List Price: Relisys RE1520, $995. Relisys, 320 S. Milpitas Blvd., Milpitas, CA 95035; (408) 945-1062.

CIRCLE **438** ON READER SERVICE CARD

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SPECIALS

TOSHIBA T1000 $749

The Toshiba T1000 is the perfect second PC! It comes with 512K of ram, a 720K floppy drive, a supertwist LCD screen and MS-DOS in rom! All this in a battery-powered 7 pound package. A 768K ram card is just $269 and can be set as base, expanded, or a non-volitile ram disk.

Panasonic KX-P1124 24 Pin Printer $309

Panasonic's new 24 pin dot matrix printer gives you more features per dollar! It comes with paper parking and three paper paths for easy handling. The EZ-set operator panel lets you choose from five fonts, six pitches, perf cut and more. Its 11.7" carraige is perfect for envelopes or single sheets in landscape mode. All this and a two year warranty.

HARDWARE

PRINTERS

	LIST	FAST
ALPS		
Allegro 24	499	319
Citizen		
120D	229	145
180D	259	165
MSP40	449	290
Tribute 124	599	429
Diconix		
150P	499	299
Epson		Call
Fujitsu		
DL3400	995	549
NEC		
P2200	569	339
P5200	799	509
P5300	1049	669
LC890	4799	Call
Okidata		
182 Plus	319	219
320	499	329
390	699	469
393	1499	949
Panasonic		
KXP1180	300	Call
KXP1191	400	Call
KXP1124	529	309
KXP1595	749	419
KXP1524	949	519
KXP4450	2595	1499
Star		
NX1000	289	169
NX2400	499	309
NB2410	699	429
Toshiba		
P321SL	749	459
P341SL	999	599
P351SX	1499	929

BOARDS

	LIST	FAST
AST		
Hot Shot 286	645	339
Six Pak Plus 64K	210	119
DTK		
286 10mhz M/B	499	249
XT 1.2mb FDC	79	45
Everex		
1200B Int Modem	149	69
2400B Int Modem	249	129
Genoa		
Super EGA Hi-Res+	399	169
Super VGA #5100	445	239
VGA Hi-Res #5200	645	359
Hercules		
Graphic Card +	299	169
Intel		
8087-2	250	149
80287-10	480	249
Above Board Plus	795	419
Orchid		
ProDesigner	499	299
Tiny Turbo 286	445	269
Twin Turbo 12mhz	645	359
Paradise		
Autoswitch 480	349	Call
VGA Plus	399	259
VGA Plus 16	499	299
VGA Professional	799	Call
Practical Peripherals		
1200B Int Modem	99	65
2400B Int Modem	199	149
Prometheus		
Promodem 2400B	199	129
Promodem 2400G	249	159

The Complete PC	LIST	FAST
Answering Machine	349	209
Fax 4800	399	235
Hand Scanner 400	249	149
USRobotics		
1200 Baud Internal	149	69
1200 Baud External	179	89
2400 Baud Internal	249	119
2400 Baud External	279	149
Video 7		
1meg Write VGA	549	335
Vega Deluxe	379	Call
Vega VGA	499	259
V-RAM VGA	899	469

LAPTOPS

	LIST	FAST
Megahertz Modems		
2400B Toshiba	299	149
2400B NEC, Epson Mitsubishi or Zenith	399	199
Mitsubishi		
MP-286L Dual	3195	1879
MP-286L 20mb	4595	2449
NEC		
Multispeed EL II	2295	1449
Multispeed HD	3695	2249
Toshiba		
T1000	1249	749
T1200F	2099	1369
T1200FB Backlit	2399	1499
T1200HB Backlit	3599	2399
T1600	4999	Call
T3200	5799	3495
T5100	7499	4495
Zenith		Call

MONITORS

	LIST	FAST
Magnavox		
78M749 VGA	229	149
9CM082 VGA	649	419
Mitsubishi		
1409 RGB	399	259
1410 EGA	599	399
Diamond Scan 1381	799	479
NEC		
Multisync II	899	575
Multisync Plus	1399	869
Princeton		
Max15	389	Call
Ultrasync	849	489
Ultra 16	1375	859
Selko CM1430	995	599
Sony		
1302 Multiscan	995	659
1303 Multiscan	825	469
Zenith 1490	999	599

DISK DRIVES

	LIST	FAST
Miniscribe		
40MB AT #3650	499	319
Mitsubishi		
40MB AT MR535 22ms	825	399
Seagate		
20MB XT Kit #225	599	267
30MB XT Kit #238	699	287
40MB AT #251	899	349
40MB AT #251-1	999	449
80MB AT #4096	1199	549
Toshiba		
360K Floppy	119	.69
720K 3.5" Floppy	149	79
1.2MB 5.25" Floppy	149	79
1.44MB 3.5" Floppy	189	99

Call On Non-Listed Items

SOFTWARE

Database

	LIST	FAST
Clipper	699	399
DataEase	600	379
dBase IV	795	449
dBXL Diamond	199	105
Foxbase Plus	395	185
Paradox	725	429
Quartz	795	449
RapidFile	295	179
Rbase for DOS	700	419
Reflex	150	90
Q & A	349	199

Desktop Publishing

Byline	295	175
GEM Desktop Pub.	299	169
Pagemaker 3.0	795	Call
PFS:First Publisher	129	69
Publisher's Paintbrush	285	149
Ventura 2.0	895	489

Financial

Bedford Integr. Acct.	249	139
BPI		Call
Computer Associates		Call
DAC 3.0	99	59
DAC Payroll 3.0	99	59
Dollars & Sense	179	99
Managing Your Money	199	117
Peachtree Complete II	199	149
Turbo Tax 1040	75	42

Graphics

	LIST	FAST
Deluxe Paint II	105	67
First Graphics	129	Call
Freelance Plus	495	Call
GEM Artline	495	269
GEM Draw Plus	299	165
Generic Cadd Level 3	200	97
Graph Plus	495	299
Harvard Graphics	495	Call
Perspective Jr.	149	85

Integrated

First Choice	159	Call
Works	149	89
Windows 286	99	59
Windows 386	195	117

Mice

Logitech C7 Serial/Bus	119	65
Logitech HiRes Bus	150	79
Microsoft Serial/Bus	150	95
Microsoft W/ Windows	200	129
OmniMouse	89	45
PC Mouse II Serial/Bus	149	82

Power Protection

Curtis Ruby Plus	115	59
Datashield 85	90	50
Datashield 100	99	57

Programming

	LIST	FAST
Macro Assembler	150	89
Norton Guides (Specify)	100	58
Turbo Basic	99	60
Turbo C 2.0	149	90
Turbo Pascal 5.0	149	90
Quick Basic	99	60
Quick C	99	60

Spreadsheets

Allways	150	82
Excel	495	Call
Lotus	495	Call
Lucid 3-D	149	79
Quattro	248	149

Utilities

CoreFast	149	87
Desklink	170	95
Desqview	130	73
Fastback Plus	189	99
FastTrax	60	37
Formtool	95	54
Laplink Plus	140	77
Norton Advanced	149	74
PC Tools Deluxe	80	36
Sidekick Plus	195	119
XTree	70	34

Word Processors

	LIST	FAST
Ami	149	89
Easy Extra	99	55
GEM First Word Plus	199	117
Grammatik III	89	49
Manuscript	495	Call
Multimate Adv. II	565	247
Professional Write	199	109
Rightwriter	95	49
Sprint	195	119
Q & A Write	199	109
Webster's Writer	60	47
Word	450	Call
Word Perfect	495	Call
Word Perfect Library	129	60
WordStar Prof. 5.0	495	219

Call On Non-Listed Items

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Download, BackLoader: Two TSRs for Downloading Soft Fonts

PC HANDS ON

BY EDWARD MENDELSON

In software as in science, the same idea often occurs to two people at the same time. The latest synchronistic software discovery is the memory-resident soft-font downloader.

Elfring Soft Fonts' $30 *Download* and Roxxolid's $29.95 *BackLoader* let you download soft fonts to an HP LaserJet while using other applications. Each lets you download a predefined set of fonts when the program first loads into memory. Each then pops up over other applications and lets you download additional fonts.

When you pop up *Download*, it displays the soft fonts in a predefined directory on your disk, tells you the name of each font, and lets you mark any or all for downloading. *Download* also has built-in functions that let you reset the printer, eject a page, or perform other useful functions. You can use *Download* as a TSR or simply run it from the DOS command line to download a group of fonts without remaining in memory. The package also works with DeskJet fonts.

For an extra $15, Elfring Soft Fonts throws in a set of 26 soft fonts corresponding to Helvetica and Times Roman in sizes from 8 to 18 points. You also get a manual that tells you everything you need to know about soft fonts.

BackLoader provides more extensive features, but its awkward design makes you jump through a lot more hoops before you can use them. If you want to select fonts to download while *BackLoader* is in memory, you first have to write files containing lists of the fonts. Also, when you pop up *BackLoader*, you have to enter the name of the list file—and remember to type "@" before the name.

Although *BackLoader* lets you download groups of files with one command, it can be more trouble to type in a file list in *BackLoader* than it is to mark fonts on *Download*'s pop-up screen. And if you want to use *BackLoader* for anything as simple as ejecting a page, you have to figure out HP's elaborate control codes and type them into special command files first. *BackLoader*'s manual is designed more for font hackers than for font users.

But *BackLoader* has some advantages not found in *Download*. It occupies only 15K of memory, compared with *Download*'s 39K, and it works with printers connected to serial ports. *BackLoader* downloads fonts in the background and lets you get back to work on other applications, although this feature is an advantage mostly when you download large sets of fonts at a time.

If you like to experiment with different fonts, *Download* is the best choice. If you always use the same sets of fonts, *BackLoader* may be preferable despite its clumsy interface. But don't choose on the basis of price—there's only a 5-cent difference between them. PC

PC MAGAZINE FACT FILE

BackLoader
Roxxolid Corp.
3345 Vincent Rd.
Pleasant Hill, CA 94523-4318
(415) 256-0105
List Price: $29.95
Requires: 15K free RAM, DOS 2.0 or later. Not copy protected.

CIRCLE 440 ON READER SERVICE CARD

Download
Elfring Soft Fonts
P.O. Box 61
Wasco, IL 60183
(312) 377-3520
List Price: $30; $45 with fonts
Requires: 38K free RAM, DOS 2.0 or later. Not copy protected.

CIRCLE 439 ON READER SERVICE CARD

XyWrite Adds Point-and-Shoot Menus

PC HANDS ON

BY CRAIG L. STARK

While *XyWrite* users are quick to praise its speed and power, they have always had to admit that their favorite word processor is not the easiest program to master. In its newest incarnation, Version 3.54, however, *XyWrite III Plus* has added an optional, menu-driven interface called A La Carte that allows you to "point and shoot" your way through *XyWrite*'s myriad features.

To access A La Carte, you hit F6 from within *XyWrite*. This brings up a series of Lotus-like menu selections, including a one-line explanation of the highlighted option. You pick a category from the A La Carte menu either by moving the highlight with the cursor keys and hitting Enter or by pressing the designated (usually the first) capital letter. This opens up a window in which you enter your specific choices and any needed parameters such as filename or margin position.

If you're uncertain how to proceed at any point, you can call up the fully coordinated help screens, some of which extend through multiple pages and all of which are helpful.

A La Carte is remarkable less for what it omits (multiple-column tables, modifying printer drivers and keyboard layouts, advanced programming) than for what it manages to include (mail-merge, footnote styles, a complete, updatable listing of all program defaults). The on-screen explanations are crystal clear and explicit, albeit that one or two terms ("save/get" for what most people call "macro," for example) reflect XyQuest's own vocabulary. Most beginning users will never have to refer to the main *XyWrite* manual at all.

Experienced *XyWrite*rs, accustomed to the flexibility and speed of *XyWrite*'s command-line interface, will probably want to continue as usual, forgetting that A La Carte is even there. For the new or occasional user, however, this latest *XyWrite* enhancement is a godsend. PC

PC MAGAZINE FACT FILE

***XyWrite III Plus*, Version 3.54**
XyQuest Inc.
44 Manning Rd.
Billerica, MA 01821
(617) 671-0888
List Price: $445 (includes A La Carte); upgrade from *XyWrite III Plus*, $35; upgrade from *XyWrite III*, $50; upgrade from *XyWrite II Plus*, $150.
Requires: 384K RAM (hard disk recommended), DOS 2.0 or later. Not copy protected.

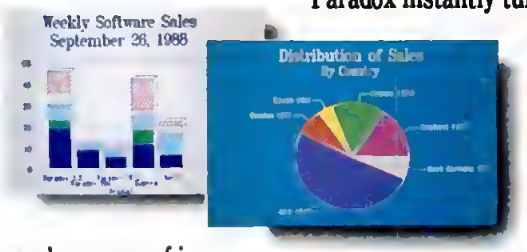
CIRCLE 447 ON READER SERVICE CARD

Power without pain.

Multi-table form dynamically displaying information from three related tables.

You don't have to be a programmer to have easy access to our highly sophisticated, powerful relational database, Paradox® 3.0.

Paradox 3.0 is all powerful and never painful because *it* makes all the complex inside moves, you don't. While it does the complex for you, the complexity is hidden beneath clear, natural, even intuitive pathways and patterns that make life easy for you.



With Paradox 3.0, there are no Unclears, no Unknowns. You don't need an army of in-house technical support people. And best of all, you *don't have to be a programmer* to be a pro with Paradox. It's all gain, no pain.

"Query-by-Example" for example

Use this checkmark and you're using QBE.

It's that easy. Let's say you need to know in a hurry which of your Los Angeles customers bought more than 5 pairs of white shoes. First ✓ the customer field, then type "LA," "white," and ">5," and you're done. Paradox gives you the right answer right now. And how much programming to do all that ? Zero.

If your database experience so far is limited to the flat-file type rather than relational, or even if a spreadsheet is the only program you've used before, Paradox gets you up and running immediately with just a ✓.

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Paradox has become the leading networker because it handles multi-users intelligently. If someone in your group or network has accessed a record, automatic record-locking keeps everyone else from changing it.

That way, two or more people can't change the same data at the same time. (As a bonus, Paradox also tells you *who* is using a record at a particular instant.)

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Paradox, for the looks of things

Presentation-quality graphics are another Paradox distinction. They give you and your work the professional look.

Paradox instantly turns your tables into graphs with *one* keystroke—and in multiuser environments, with a few keystrokes your graph can show up-to-the-minute changes. Not only does everyone get the picture, they get an accurate picture.

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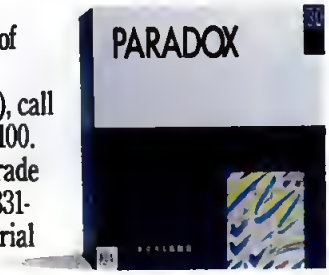
Paradox 3.0 is the latest addition to the award-winning Paradox Family. **Paradox OS/2 and 386 received PC Magazine's BEST OF 1988 AWARD in the database category.**

✓ it out

To order a trial version of Paradox 3.0 ($14.95) or a demonstration disk ($4.95), call (800) 345-2888, extension 100. Paradox owners may upgrade ($175.00) by calling (800) 331-0877. (Please have your serial number available.)



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BORLAND

Code: MP09

CIRCLE 377 ON READER SERVICE CARD

PreVIEW: CADD-Minded Groupware Streamlines Drawing Review, Annotation

PC HANDS ON

BY JEFF PROSISE

Engineering and architectural drawing review can be a sloppy, time-consuming process. *PreVIEW*, a new package from Rosetta Technologies, offers a streamlined alternative to marking up drawings by hand.

PreVIEW makes it easy to plot, annotate, and compare drawings from other CADD systems. Installed on a standalone PC, it transforms its host into a powerful drawing comment and review station. Installed on a network, it allows drawings to be stored on the server and accessed from individual stations running *PreVIEW*.

The package accepts files in two formats—IGES and CalComp plot. With IGES, you'll be able to bring drawings into *PreVIEW* from almost any other mainframe- or microcomputer-based CADD system, including *AutoCAD*. In the rare cases in which IGES isn't available as an output option, CalComp plot format probably will be.

In addition to its DOS support, *PreVIEW* supports Unix-based Sun-3 workstations and Apollo workstations running DOMAIN/IX or AEGIS. It supports IBM's *PC Local Area Network Program* (*PC LAN*) and Sun NFS (Network File System) networks.

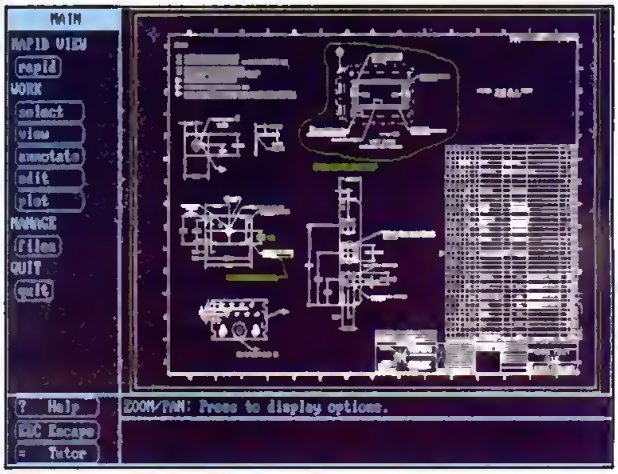
After an IGES or CalComp drawing file is converted into a *PreVIEW* drawing file with a utility *PreVIEW* includes, it can be called up and displayed as if it were in its native CADD format. For viewing, *PreVIEW* offers all the functions of a CADD system: panning, zooming, windowing, and the ability to hide or display drawing layers.

In addition, through a mechanism known as the "stack," you can lay up to three drawings on top of one another and display them simultaneously. Comparing drawings for changes between revisions has never been easier.

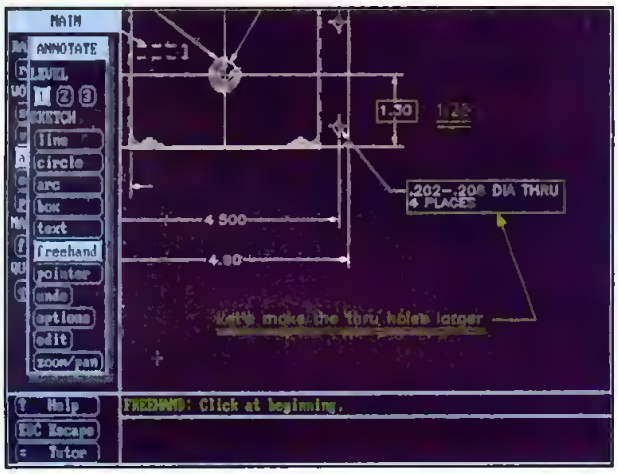
PreVIEW really shines when it comes to annotating drawings with graphics and text. If you want to comment a drawing and pass it back to its originator, you simply insert a blank overlay into the three-tiered drawing stack and select Annotate from the main menu. Notes and sketches are added to the overlay so that the original drawing file isn't changed. Another option lets you output annotations to an IGES file, where comments can easily be incorporated back into the original.

PreVIEW's annotation functions, which let you draw circles, arcs, lines, boxes, arrows, text, and freehand figures, work in a smooth, logical manner that minimizes the amount of time you'll spend learning to use them. And if you make a mistake, no problem—just select Undo or Edit from the Annotate menu to correct it.

PreVIEW's ability to handle drawing files goes beyond flat 2-D viewing. For 3-D models imported through IGES, it permits you to change the position of the viewpoint in space and then generate new drawing files and plots from the new view.



PreVIEW *imports files from most mainframe- and PC-based CADD systems and lets multiple users review and annotate drawings. Above, annotations are shown in yellow.*



PreVIEW *lets you annotate drawings with freehand sketches or by using predefined entities such as lines, boxes, and arcs.*

On the downside, *PreVIEW*'s automatic installation program ranks as one of the most obnoxious ever devised. After revising your CONFIG.SYS and AUTOEXEC.BAT files for you, it promptly litters your root directory with unwanted subdirectories and fills them with files and even more subdirectories. The installation program asks you what drive you'd like to install *PreVIEW* on but still copies a portion of *PreVIEW* to drive C:—even if you specify a different drive letter. And when you're asked to designate the port your mouse is attached to, the dedicated mouseport featured on IBM's PS/2 machines is conspicuously absent. If you use a serial version Microsoft Mouse with a PS/2, you'll have to disconnect it from the mouseport and plug it into the serial port. If you have an IBM mouse, you're out of luck.

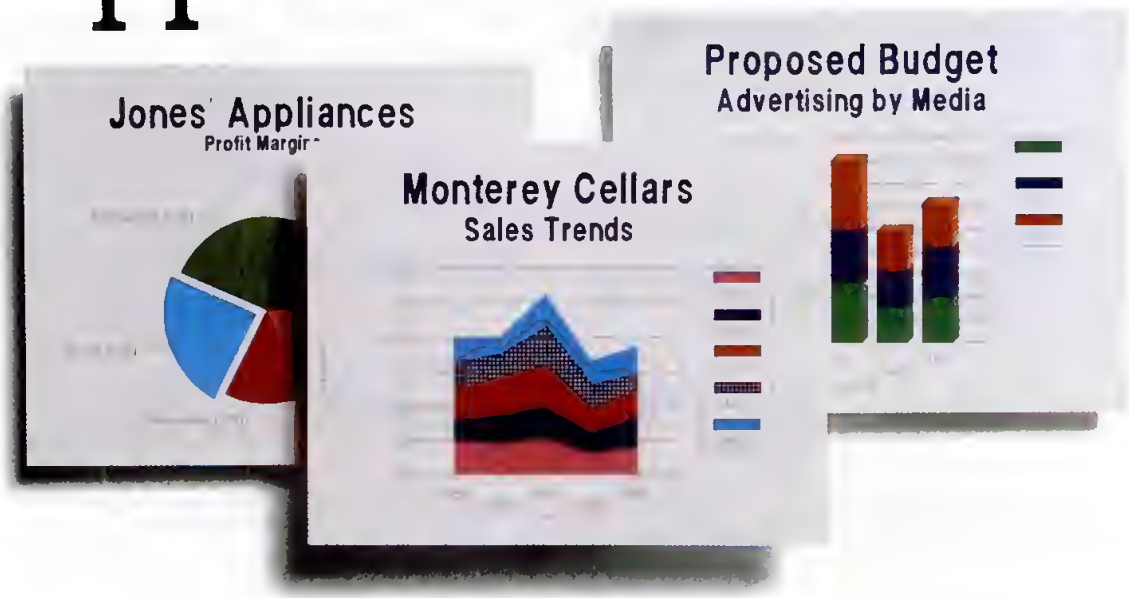
Despite these shortcomings, *PreVIEW* is a powerful package that illustrates how workgroup software can benefit engineering and scientific organizations. Whether you use it on an independent PC or in conjunction with a network, you're sure to agree that it beats the red-pencil approach to reviewing and commenting drawings. PC

PC MAGAZINE FACT FILE

***PreVIEW*, Version 1.0**
Rosetta Technologies Inc.
1225 NW Murray Rd.
Portland, OR 97229
(503) 626-2288
List Price: $2,595
Requires: 640K RAM, IBM PC AT or compatible, hard disk, EGA or VGA display adapter, 80287 or 80387 math coprocessor, Microsoft Mouse, DOS 3.1 or later.
In Short: A powerful CADD utility designed for group review and annotation of drawings from any CADD package. Supports IBM's *PC LAN* and Sun NFS networks. Not copy protected.

CIRCLE 445 ON READER SERVICE CARD

Appearances count.



Quattro: The Professional Spreadsheet

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Quattro does the impossible.

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Quattro is the way things should be instead of the way things are with the leading spreadsheet.

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CIRCLE 137 ON READER SERVICE CARD

WARNING!

PC WEEK: "PrintQ could become very addicting!"

PrintQ® VERSION 4.0 High Productivity Print Spooling Software for Power-Users.

Boost your PC's capabilities with PrintQ, the original, professional quality print spooler with mainframe power that lets you compute while you print. Without waiting and without wasting time.

Run your application programs as usual. PrintQ intercepts documents bound for the printer, spools them to *disk*, and prints them automatically. Also PrintQ is completely programmable, 100% software and installs in seconds.

The "Pop-up" Status Display allows you to view the print sequence and control document printing. Each document is maintained separately as a "PrintFile," which can be controlled individually, to meet your specific needs. For example, you can print 5 copies of a memo, but only one copy of a letter.

PrintQ 4.0 Offers PC Users These Powerful Advantages.

- Spools to disk, not RAM.
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- Choose any of your printer's fonts or functions for each or every PrintFile.
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Some "warnings" were meant to be ignored.

SDI
Software Directions, Inc.
1572 Sussex Turnpike
Randolph, New Jersey 07869

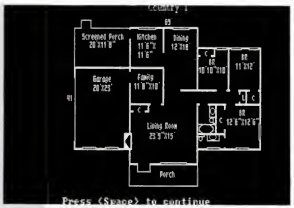
CIRCLE 471 ON READER SERVICE CARD

PC UPDATE

by Paula Seefeldt

Design Your Own Home Expands Libraries

Abracadata has added four Architecture Libraries to its *Design Your Own Home* program. Each library includes 48 plans and caters to a wide range of taste, including Colonial-, Tudor-, and Cape Cod–style homes. The libraries may be incorporated into any PC drawing program that accepts .PCX files. The program is only CGA compatible. Each library retails for $29.95. Abracadata Ltd., Eugene, Oreg.; (503) 342-3030.



Abracadata designs a country home.

GRiD Adds Disk Drive

GRiD Systems now offers a 100MB Winchester disk drive option for its battery-powered 80C286 and 80386 **GRiDCase** laptop computers. The laptops have also been enhanced with brighter LCD displays, extended battery life, and increased power management and mass storage. The 80C286 GRiDCase 1520 retails for $3,495. The 80386 GRiDCase 1530 lists at $4,695. GRiD Systems Corp., Fremont, Calif.; (415) 565-4700.

WordPerfect Supports JT-Fax

WordPerfect has designed a new driver to allow *WordPerfect*, **Version 5.0**, users to send and receive faxes from PCs that use Quadram's **JT-Fax** facsimile system. The driver lets users create files and then specify the time and destination for transfer. Normal and compressed fonts are available. Drivers may be ordered for a $15 shipping and handling fee. WordPerfect Corp., Orem, Utah; (801) 225-5000.

RealWorld Gets New Interface

RealWorld is now shipping Version 5.0 of its 11 accounting software packages. The enhanced packages offer a new user interface with pull-down menus, windows, and user-defined "short-cuts" for greater ease of use. In addition, Version 5.0 has increased speed, simplified installation procedures, and password protection. Packages retail for $695 for single-user versions, $795 for network versions, and $1,000 for source code. RealWorld Corp., Concord, N.H.; (800) 255-1115.

Smalltalk Bundles Spelling Checker

Digitalk is marketing its *Smalltalk/V286*, **Version 1.1**, with its newest extension kits, *Carleton Tools* and *Carleton Projects*. The kits are designed to work as time-saving tools with *Smalltalk*. *Carleton Tools* contains a spelling checker, PostScript code, and a software floating-point calculator. *Carleton Projects* adds an application browser extension, a 3-D editor, and a Directed Acyclic Graph browser. The extension kits are now being offered at a discount when purchased together. Separately, each kit retails for $49.95. Digitalk Inc., Los Angeles, Calif.; (213) 645-1082.

ProCursor Incorporates New Menus

PreCursor, the menu system from The Aldridge Co., has redesigned its interface. Version 4.0 has pull-down windows, dialog boxes, point-and-shoot lists, hotkey access, and color configuration. The new interface includes ID validation, password protection, multiple menu levels, and network compatibility. For advanced users, special control commands and API hooks create input options. *PreCursor* also offers dynamic menu generation to create menus for programs in other computers automatically. Upgrades are $25.95 for registered users. New packages retail for $96. The Aldridge Co., Houston, Tex.; (713) 953-1940.

Hooleon Adds KeyCaps

Hooleon has incorporated **IBM KeyCaps** in its custom key imprinting services. The KeyCaps enable users to completely customize their keyboards for reduced training costs and increased efficiency. KeyCaps are available in ivory or gray for 1x, 1.5x, 2x, and 2.25x sizes. 1x sizes come in a wide array of colors. Prices for individual KeyCaps range from $.75 to $3.35, depending on size and color. Discount rates are available for large-quantity purchases. KeyCaps kits are also available for *WordPerfect* 5.0 and IBM 525 emulation. Hooleon Corp., Cornville, Ariz.; (602) 634-7515.

KeyCaps expand key imprinting services.

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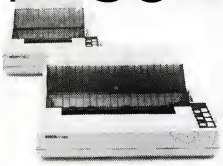

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Bill Howard

PC Dictionary: The CPU

"Simple enough for home use, [the Epson Apex Plus] . . . can be learned in minutes. Included are CPU (control pick-up unit: keyboard and dual disc drive) and color monitor."

—*Spiegel 1988 Holiday Collection catalog*

PC Dictionary: MFM Controllers

"Unlike the Macintosh File System (MFM) and run-length-limited (RLL) controllers that support 17 and 26 sectors per track, the Perstor controllers use a proprietary disk interface to increase the number of sectors per track to 31."

—*Byte*, September 1988

(MFM stands for modified frequency modulation)

PC Dictionary: Operating System

"An operating system is a computer software program for linking computers of different makes that was developed by AT&T but is now used by other computer manufacturers."

—*San Jose Mercury*, October 29, 1988

Wordsmith at Work

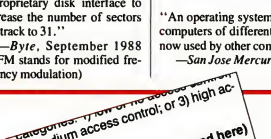
"The first customer shipment [of the IBM 3090 System 600S] . . . went to CSX Technology, a division of transportation company CSX Corp., where it will be used to manage communications and computing systems at the CSX data center in Jacksonville, Fla., and will link more than 17,000 workstations over a 20,000-mile mail network."

—*Computerworld*, October 3, 1988

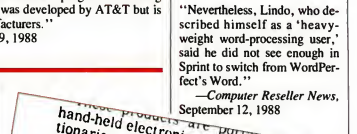
Wordsmith at Work (Twice in One Paragraph)

"Nevertheless, Lindo, who described himself as a 'heavyweight word-processing user,' said he did not see enough in Sprint to switch from WordPerfect's Word."

—*Computer Reseller News*, September 12, 1988



Security article in LAN Magazine, *October 1988*



No units of which have been sold to The New York Times. *(Business People column,* The New York Times, *September 29, 1988)*

PC Dictionary: Software

"The [Orange County, Fla., school] district is buying computer software. Software translates computer language into English."

—*The Orlando Sentinel*, August 25, 1988

PC Dictionary: Interleave Ratio

"[*SpinRite*'s] principal application is to recondition Winchesters whose read/write heads have 'drifted' out of alignment after months of use. When that happens, the disk's interleave ratio (the number of times a platter revolves as the disk reads contiguous data sectors) often slips from the typical 3:1 into higher ratios."

—*PC World*, August 1988

Excepting, of course, the remaining few who learned on typewriters with no function keys at all. (Northgate Computer Systems ad)

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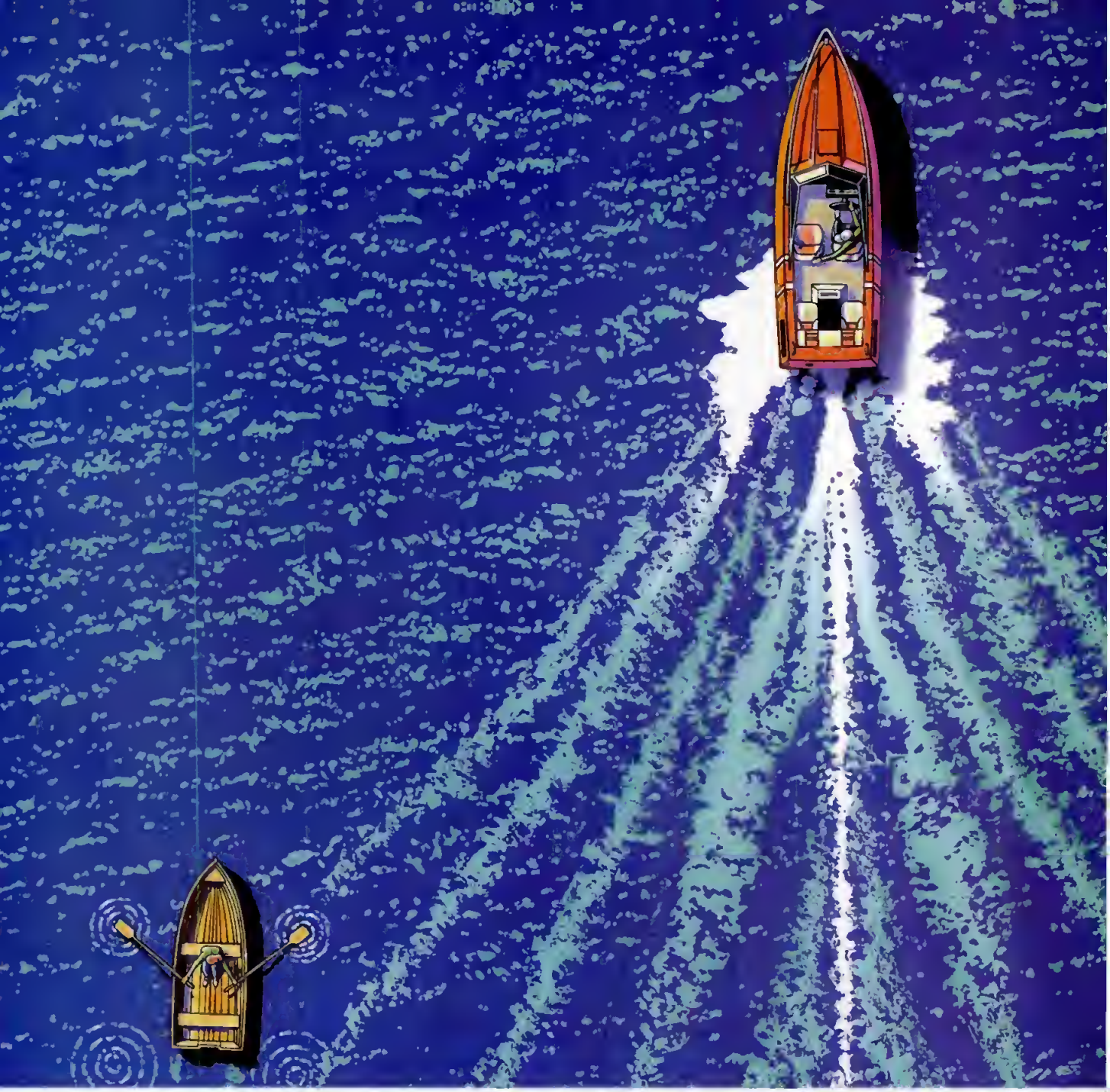
Winners this issue: Lewis Horowitz (copmputerized speller), Mike Radledge (LAN chart), Eric Andersen (rail network), Ben Buisman (heavyweight user), Joan Abrams (control pick-up unit), Scott Luther (interleave ratio), Chris Wong (MFM), William Walstrom (operating system), Morris Daniels (software).

Illustration: Richard Tennant



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■ BILL MACHRONE

COPROCESSING: WHO NEEDS IT?

Coprocessors are everywhere. Communications boards, graphics cards, even lowly disk controllers. Are we into multiprocessor overkill? Will we need OS/2 just to manage them all?

With all the talk about coprocessing these days, you'd think it was something new. And while it may be new to the PC, it's been around for more than a decade. Coprocessing is the cornerstone of mainframe architecture.

The hallmark of the mainframe is that it has at least one processor to handle each kind of task. The CPU in a business mainframe does all the compares, string moves, calculations, sorts, and lookups required by the applications. It's also running the operating system. If the math workload gets too heavy, your account rep sells you a math coprocessor. Instead of the leggy little chip that goes into your PC, a mainframe's math coprocessor may be a couple of largish circuit boards or a cabinetful of electronics.

Unlike its PC-based equivalents, the mainframe has coprocessing units that tend to be much more independent of action. Some printer subsystems, for instance, have their own local memory and disk drives. They are computers in their own right, but utterly dedicated to controlling the printers. The mainframe's various devices communicate with the CPU over a high-speed bus called a channel. Some of the channels even have their own dedicated controllers—also fully fledged computers but charged with a specific task, such as controlling memory access.

POWER BOOST What goes around comes around. In the search for ever-higher performance, today's PCs are looking more like their mainframe forebears. More and more, the subsystems in the PC are being redesigned as coprocessors and a new wave of aftermarket products are becoming available to bring coprocessing power to your existing machine.

The most visible among these products is Intel's Connection CoProcessor, which gives you a 9,600-bit-per second fax modem that operates almost entirely in the background thanks to its on-board 80188 processor and clever use of expanded memory. Intel's board is further freed from the petty tyrannies of most background tasks by talking to applications through CAS, the Communicating Applications Specification. The Connection CoProcessor is not alone, however, as a coprocessor-controlled fax board. The Complete PC's new Complete Fax 9600 does its work in the background with the help of a lowly but inexpensive 8-bit onboard processor.

The size and power of the coprocessor are relatively immaterial; the real gains are twofold. One is the coprocessor's ability to execute a program without burdening the main processor. The other is the flexibility it gives the designer, who can often reprogram rather than rewire a board under development.

Illustration: Jean-François Allaux

Fax is a form of asynchronous communication. The hassle of async is that you never know exactly when a character will arrive—only that you have to do something with it before the next one appears. This is very taxing on the PC if you attempt to handle fax operations as an interrupt-driven background task. Even 1,200-bps communications in the background can weigh heavy on the responsiveness of foreground tasks. A fax modem is ideal for coprocessing because it needn't adhere to the IBM-standard communications port addresses. Standard communication software, however, wouldn't know how to deal with a modem that wasn't addressed to one of the standard COM addresses. The future will bring modems that know how to live under a coprocessor, freeing your PC from the task of managing the unpredictable assault of arriving characters.

Coprocessors have been available for printers for a while now. The LaserMaster, from LaserMaster Corp., is an interesting example. It gives the ubiquitous LaserJet all the power of PostScript fonts without the usual PostScript speed penalty. Of course, the LaserMaster isn't a full PostScript interpreter, so you can't do all the fancy graphics. But there's no faster way to get a wide variety of fonts, in any size, onto the page.

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CIRCLE 222 ON READER SERVICE CARD

■ **BILL MACHRONE**

processors extends the life of DOS by reducing the need for the multitasking that OS/2 offers. And you'd be wrong. The truth is that each coprocessor you add under DOS requires its own TSR program, uses expanded memory to hide pieces of itself, gobbles up the system's interrupts, and becomes a potential disaster area of incompatibilities and conflicts.

OS/2's multithreaded, multitasking environment is ideal for the job. In fact, coprocessing is likely to be the solution for some looming OS/2 bottlenecks. For instance, OS/2 is not wildly impressive when managing async communications. The architecture of setting up a task (or a thread within a task) is straightforward—cleaner than it is in DOS. But OS/2 is big; it may be trying to keep a lot of balls in the air as it gets pestered by the modem. The great advantage of coprocessors is that they interrupt less often, with more information, and it generally takes far less effort for the main processor to do something useful with that information.

Indeed, coprocessors can be the stimulus for dramatic new hardware designs. The Plus Impulse is a disk subsystem with an intelligent controller (read *dedicated computer*) that can manage up to 16 drives with a single adapter card. One of the things disk designers strive for is more speed through overlapped seeks, buffered reads and writes, and other applications of intelligence to the task of retrieving data. The Plus Impulse might give you some of that performance increase under DOS, but it really comes to life in a multitasking environment. Suddenly you're free to dedicate one disk to each task or to gang all of the disks onto one task, or any mixture that makes sense for your applications. Or you're free to write a driver that does the load balancing and optimization for you. This may seem like overkill for a single-user system—and it is. But it's exactly the shot in the arm that LAN servers need. OS/2 LAN Manager strikes me as the one to provide it.

This is only a cursory look at a complex subject. But keep in mind that we're on the verge of a vast new contest between hardware and software, as each strives for the honor of giving you the biggest performance boost.

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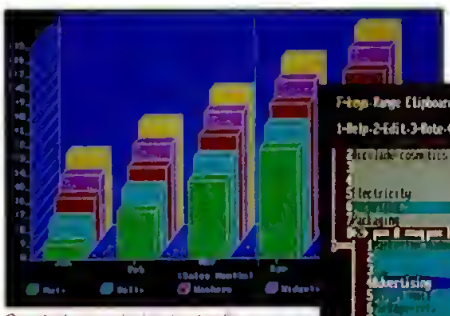

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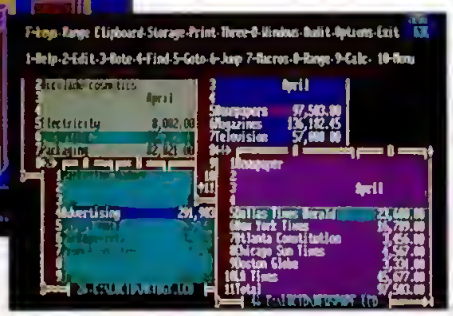

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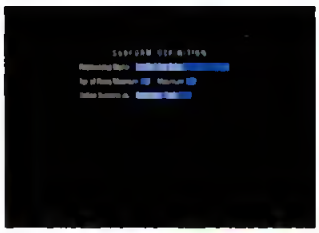

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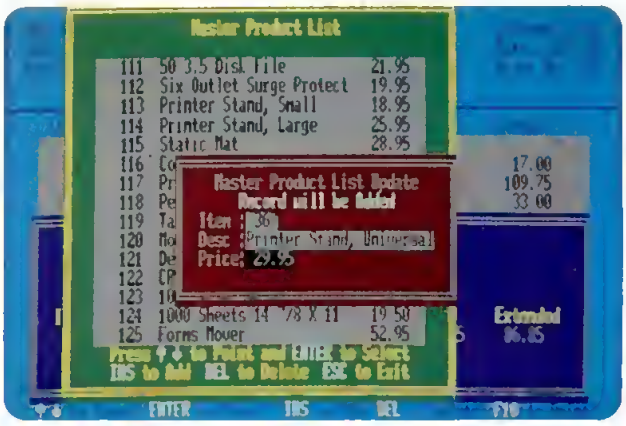

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CIRCLE 134 ON READER SERVICE CARD

■ JOHN C. DVORAK

THE REAL RADIO DAYS

Looking back to the heydey of the radio industry brings to mind some eerie parallels between it and the bloated personal computer market of today.

Those who ignore history are doomed to repeat it.

Some years ago I cited the turn-of-the-century automobile rage as a metaphor for the computer business. There were hobbyist magazines galore, and countless companies were making cars. At the time, the industry seemed like a perfect parallel model for our computer industry. Now I'm not so sure. There are still some parallels, but they are blurred by the fact that the automobile is a mechanical device.

A better parallel model may be the early 1900s radio mania that swept the country and that brought electronics to the layman. Early radio mania is the real ancestor to our current preoccupation.

Radio days began with the first successful radio magazines. On the West Coast there was *RADIO*, first published in San Francisco in 1917 as *Pacific Radio News*. On the East Coast there was *Popular Radio*, which began in 1911. The scene was soon swamped with other magazines, including *Radio Instructor*, *Radio News*, *Radio World*, *Radio-Craft*, *Radio Design*, *Radio Retailing*, and *Radio Age*. Inside each issue you'd find the latest in radio equipment. It's fascinating.

BABY GIANTS For instance, a glance through the January 1924 issue of *RADIO* finds advertisements for manufacturers that have long since disappeared. Not surprisingly, many of today's giant corporations, then in their infancy, were represented too. Looking back, it's hard to say that it was predictable that RCA would survive and grow while the Colin B. Kennedy Company, manufacturer of the then-modern Kennedy radio ("The Royalty of Radio") would disappear.

Then there was A.H. Grebe & Co., maker of the Grebe 13, a famous receiver in 1924. Turn the page and you'll find an ad from an Oakland, California-based company with the peculiar name of Magnavox. Its claim to fame was its power amplifiers and a $60 R2 18-inch curvex horn reproducer. (Magnavox had to compete with Trinity Radio Corp. and its $30 Type C2 21-inch fiber horn.) Even fancier devices could be had from Pathe Phonograph and from Boudette Manufacturing with its Sonochorde.

Battery makers were other big advertisers. Most radios back then needed large radio batteries to work. Exide and Ever-Ready were there with full-page ads. They did OK.

Tube companies were also prominent,

with RCA leading the pack against competitors like Sodion, DeForest Radio, Silvertone, E.B. Meyers, and others.

The curious thing about these old advertisements is that when a prominent name appears, it's seldom a maker of the radio itself. It's a tube maker, a speaker maker, a battery maker. Here are the radio magazine advertisers who actually made radios in 1924: Grebe, Mu-Rad Laboratories, Paragon, F.A.D. Andrea (with "Neutrodyne" circuitry), Cutting and Washington Radio Corp., Eisemann Magneto, Crosley, Tresco, The Precision Equipment Co., Ott Radio, Hallock and Watson, Midwest Radio, Amsco, Michigan Radio, Sleeper Radio, E.A. Corwin, and the aforementioned Kennedy Co.

You could generalize that with very few exceptions, the branded radio manufacturers were all long-term casualties in the business world. The resemblance to today's bloated market for PCs is eerie. There were a lot of radio makers, because that's where the quick money was: complete systems.

The big winner was RCA, though. Here's a company that made the radio, made the tubes that went into the radio, and eventually started a broadcasting business to produce and distribute the equivalent of software. Total vertical integration. It was the IBM of its day. Last year RCA was bought by General Electric, a maker of motors, clocks, jet engines, and appliances. The name RCA was sold to the French. There it was: the end of an era.

The good news is that it took nearly 80 years of fun to get there.

Illustration: Jean-François Allaux

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UL LISTED

CIRCLE 381 ON READER SERVICE CARD

■ JOHN C. DVORAK

INSIDE TRACK

The dark side of fax—and how to avoid it.

The **hottest technology** since the invention of the telephone is **sweeping the world and none of our high-tech observers are paying attention.** That technology is **faxes. Fax mania has become an incredible craze. I like to give people my "Has fax affected you?" test.** Two questions: (1) Have you or anyone you know within the last 12 months used the non-word *fax* as a verb? In other words, has a friend said, "Let me fax it to you?" "I can fax it." "Fax me a copy!" or used any similar phraseology? (2) Have you within the last 12 months called a phone number at the bottom of a letterhead only to hear a fax squeal over the phone line? You then look back on the letterhead to discover you mistook the fax number for the phone number? If you answered yes to either question, you've been affected.

While flying around the country recently I stopped in St. Louis, where the fax craze is part of the local radio scene. One morning a shock radio station is encouraging people to **"fax your fanny!" to the station. That means to fax (there's that new verb again!) an impression of your derriere to the bozos** at the station. Things must be dull in St. Louis. Another station wanted people to fax the DJs jokes. The DJs kept broadcasting the fax phone number. This kind of thing is happening everywhere.

While I at first liked to think that fax mania was a fad, I now realize that this is not the case. This is a **major and permanent change** in the worldwide business and communications scene. It seems to have caught everyone off guard. For one thing, the fax, domestically, is a communication medium that is not well protected by either law or practicality. Data communication is not protected by the same laws as voice communication, and it's perfectly legal to read a fax message via a phone tap.

But, **the worst thing,** insofar as privacy is concerned, is the open fax machine in an office. The device prints out everything from **junk fax** to confidential memos in full view of everyone in the office. This has got to go. Fax transmissions have to be captured as data files in a computer.

Besides the privacy issue there's another principle here: spending my money to print someone else's mail in my office on my machine is a **sacrifice** I won't make. I'd just as soon scan the image on the tube and decide later if I want to print it, like electronic mail.

Guerrilla fax fiends are already sending all kinds of junk fax, such as scans of their private parts with a terse note to various companies and political adversaries. The sociology text on this subject has yet to be written, but there seems to be something appealing about being able to transmit an instant and **anonymous cuss note** to someone you don't like via a fax. This is especially convenient for personal computer users with a Datacopy or other internal fax card that can send the same **torrid memo to 1,500 receivers** all by itself (and at an hour when the phone rates are low). It's also especially humorous (in a sick kind of way) when you know that the memo that was sent on the "open for all to see" fax machine at General Motors, for instance, will be first seen (and probably passed around) by a clerk in the office. There's a good potential to stir up some muck with this technology. And let's not forget the possibility of fax love poems, fax solicitations, fax porn, **poison-pen fax**—all new and exciting ways to embarrass people you dislike via the fax.

The key to avoiding the **dark side of the fax** is simple. (And you can save money.) If you have a PC, you buy an internal fax card. This will keep the inbound fax messages where they belong: on a disk file away from prying eyes and office snoops. And, if you want to automate sending hundreds of faxes, you can do that with one of these devices too. You'll need a good scanner and laser printer to do this right (there go the savings!). The other recommendation I'm giving is to **keep your fax number private** and keep the machine turned off when it's not in use. If someone wants to send you a fax, then they have to call and ask for permission.

Finally, some tips for the fax board makers. **It's ridiculous** to dedicate a phone line to a fax, a phone line to a modem, and a phone line to voice unless you're on the phone all day. I know guys with four lines. Bookies would turn green with envy if they saw the personal phone systems some people have.

Maximize one line. I'm about to look at some automatic switches that receive incoming calls, determine if there is a modem or fax carrier, and route the line out of the proper port: voice phone, modem, or fax. A fax card should be able to receive the call on one ring, determine the type of call, and reroute the call. If it is a voice call, a ringing sequence is reinitiated to keep the caller on the line and to ring the voice phone. The **Complete PC** has released a card with both fax and voice mail capability; this is certainly a step in the right direction. Since most fax boards already act as both 9,600-bit-per-second fax modems and 1,200-bps Hayes data modems, we definitely can **expect to see new combinations** and new ways to maximize the use of one phone line in the year ahead. After all, these technologies are supposed to save us money, aren't they?

My real point, though, is that this is the year to put a fax card into your machine. Start looking.

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PC EDITOR'S CHOICE
September 15, 1987

Breakthru 286 by *DacEasy*™ — 8MHz $395 / 12MHz $595

New to DacEasy's product line is the Breakthru 286 speedup board. Undeniably, Breakthru 286 is the most advanced, fastest, turbo board for your business dollar. Breakthru 286 boards provide the most cost-effective way to convert your PC so that it's faster than an AT without the expense. Breakthru is available in two clock speeds, 8MHz and also 12MHz that's 50% faster than regular Breakthru and up to 1000% faster than a regular PC. Installation of a half slot card (only five inches in length) means you don't even have to give up a full slot. And unlike competing products, Breakthru works in most clones and Compaq portables. Easy diagrams show how you simply place the card in an open slot, remove the original processor and connect a single cable. It's 1-2-3 installation, and there's no software required!
With its advanced technology, Breakthru 286 replaces the CPU of the PC or XT with an 80286 microprocessor. Once installed, it's running faster than an AT. Plug in an optional 80287 math

"The Breakthru 286 performed flawlessly with every application we handed it, including copy-protected programs and nine memory-resident utilities at once."
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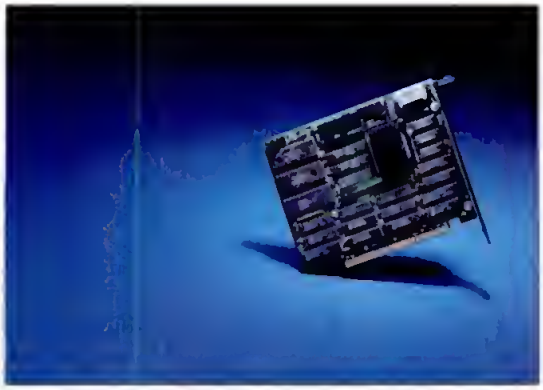
"The nation's top-selling accounting program. A flexible, inexpensive package with many unexpected features. DacEasy Accounting continues to have a lineup of extras you'd expect to find in only expensive, high end programs."
PC Magazine



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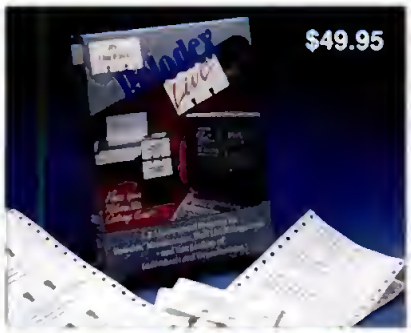
coprocessor chip for numeric intensive applications as well. A 16K cache provides zero-wait-access to the most recently used code and data. Software compatibility is virtually universal so that all system RAM, hardware, and peripheral cards can be used without modification. Breakthru operates with LAN and mainframe communication products and conforms to the Lotus/Intel/Microsoft Expanded Memory Specification (EMS). And Breakthru board's speed switching capability even lets you decrease speed on the fly for timing sensitive applications. Experience the difference with the best executed, most reliable speedup boards in the industry. And with your board, you'll receive absolutely **FREE**, Lightning, a disk-caching program, (named PC Magazine's 1986 Editor's Best) that normally retails at $69.95.
"The Breakthru 286 achieved the best performance results of the caching boards tested." **Ted Mirecki, *PC Tech Journal* (Rated #1)**



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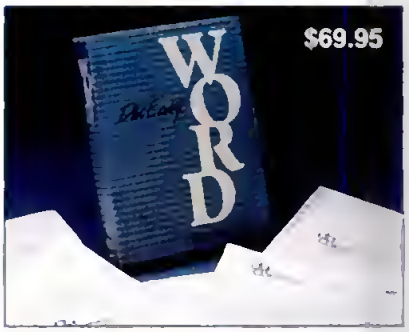

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Ask for operator #107

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Yes. There are ways to take something that's very powerful and make it easier to use.

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For starters, since there's no copy protection, you can get Symphony up and running with much quicker and easier installation.

Once up and running, bingo, you have instant access to five key business functions: spreadsheet, word processing, database, graphics and communications. So you can prepare budgets, write memos, create inventory lists without having to go through the hassle of changing programs.

But Symphony is really more than five separate programs. Because, unlike other integrated packages, Symphony lets you dynamically integrate functions. For example, when you change spreadsheet data, your graph of that data and your memo containing the same numbers automatically reflect the changes. So you get greater efficiency, and you're able to work faster too.

Plus, the Symphony spreadsheet is the fastest and most powerful spreadsheet available in integrated software, based on Lotus® 1-2-3,® the industry-standard spreadsheet technology.

We could go on about the many features of Symphony 2.0—how its macros let you automate complex or repetitive tasks and create customized applications. How the word processor now has a spelling checker and text outliner. And how database and communications have been improved.

The bottom line is that Symphony is one high performance package that's made to be opened up.

Current Symphony users: call 1-800-Trade Up and ask for extension 204 to upgrade to Release 2.0.

Lotus Symphony 2.0

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■ JIM SEYMOUR

A GUIDE TO PIMs, PART 1

Personal information managers can help you manage your time and resources effectively. But it may take more than one of these programs to meet all your needs.

No new category of PC software introduced in the past 5 years has been greeted with so much hype and hoopla as that group of programs released over the past 6 months, collectively called "personal information managers."

I try to avoid using the term because it's so maddeningly vague. But I confess I haven't anything better to offer the lexicographers, so for now let's acknowledge its tin-eared shortcomings and go on to the important issue: how we deal with the options and confusion created by these odd new packages.

LEADING THE PACK Though it's far from the only (or the best) PIM package, Lotus's *Agenda* has quickly become the best-known of the breed. It's amazing what the Lotus name—and a huge advertising budget well spent on brilliant print ads—can do to get both shelf space and mind space for a new product. Lotus has exploited this power to the hilt—as it obviously should—with spectacular results: *Agenda*'s monthly ship figures are way ahead of Lotus's business plan for the product.

I've flogged *Agenda* on many occasions, mainly because I think it's only a half-finished program, missing such basics as reasonable printing routines and another half-dozen essentials. *Agenda* is enormously powerful, but I think it asks too much of the user. Maybe in the next release . . . .

Inevitably, the noise over *Agenda* has meant that the other four or five PIMs on the market have gotten short shrift. That's sad because what I consider the most useful PIMs, and the best choices for most PC users, are among those other entries.

THREE PRINCIPLES As I've worked with these programs over the past year (beginning with beta versions), I've tried to analyze how they fit my needs in the business world. Over that time I've developed something of a "PIM strategy." The positive response I get when I talk to people about this conceptual and analytical approach convinces me that others find it as useful as I do.

First Principle of PIMs: I agree absolutely with the idea behind PIMs. I, too, have lots of little bits of information I need to keep at hand, much of which just can't be fitted reasonably into even the most free-form of database managers.

Second Principle of PIMs: I find that my informal information-management needs really fall into two categories. The first is a relatively structured group of data—but structured only in form, not content. The second is utterly spontaneous and unstructured, unpredictable in form as well as content.

My daily schedule is a good example of the first category. Clearly it is bounded, in terms of structure, by the 8- to 10-hour business day, the 5-day business week, the 4-week month. So I can hardly call it unstructured. But within that implicit structure, it's highly *un*structured.

I hate appointment-book programs precisely because of their maddeningly single-minded structure, invariably based on half-hour intervals for appointments, business days starting at 8:00 A.M. and ending at 5:00 or 6:00 P.M., and so on. What about those mornings when I come in at 6:00? And have a breakfast meeting at 7:00? Or when I schedule a series of five 10-minute back-to-back interviews with job applicants? Or when I want to remind myself at 2:28 to get out my notes for a 2:30 conference call with the West Coast staff?

The rigidity of calendar programs—which, of course, are nothing more than database programs with pretty front ends—works against that kind of flexibility. Yet the utter free-formness of a "text-base" program such as *askSam*—a splendid piece of work, upon which I rely for many other data-management tasks—is much *too* loose for my taste in managing my daily schedule.

Making quick notes while I'm on the phone is a great example of the second kind of "personal information manage-

Illustration: Jean-Francois Allaux

■ JIM SEYMOUR

ment" needs I face every day. Here I want not only a fast, pop-up note-taking tool, utterly without form or structure, but also the ability to search through a maze of those notes for common links *after* the fact—and, of course, to assemble and print documents from oddments scattered throughout those notes.

Those are two very different jobs.

And in my experience—here comes my Third Principle of PIMs—those jobs are *so* different that no existing PIM (or other kind of PC program) can handle both kinds of tasks very well.

USING A PIM AS A NAIL When I've discussed my approach to PIMs with other businesspeople who like to use PCs, almost all have agreed that they, too, face the same dichotomy in their informal data-management requirements. And while we can adapt or stretch or turn inside out any of the PIMs available today, turning them into things their authors never intended, we wind up with an awfully blunt tool.

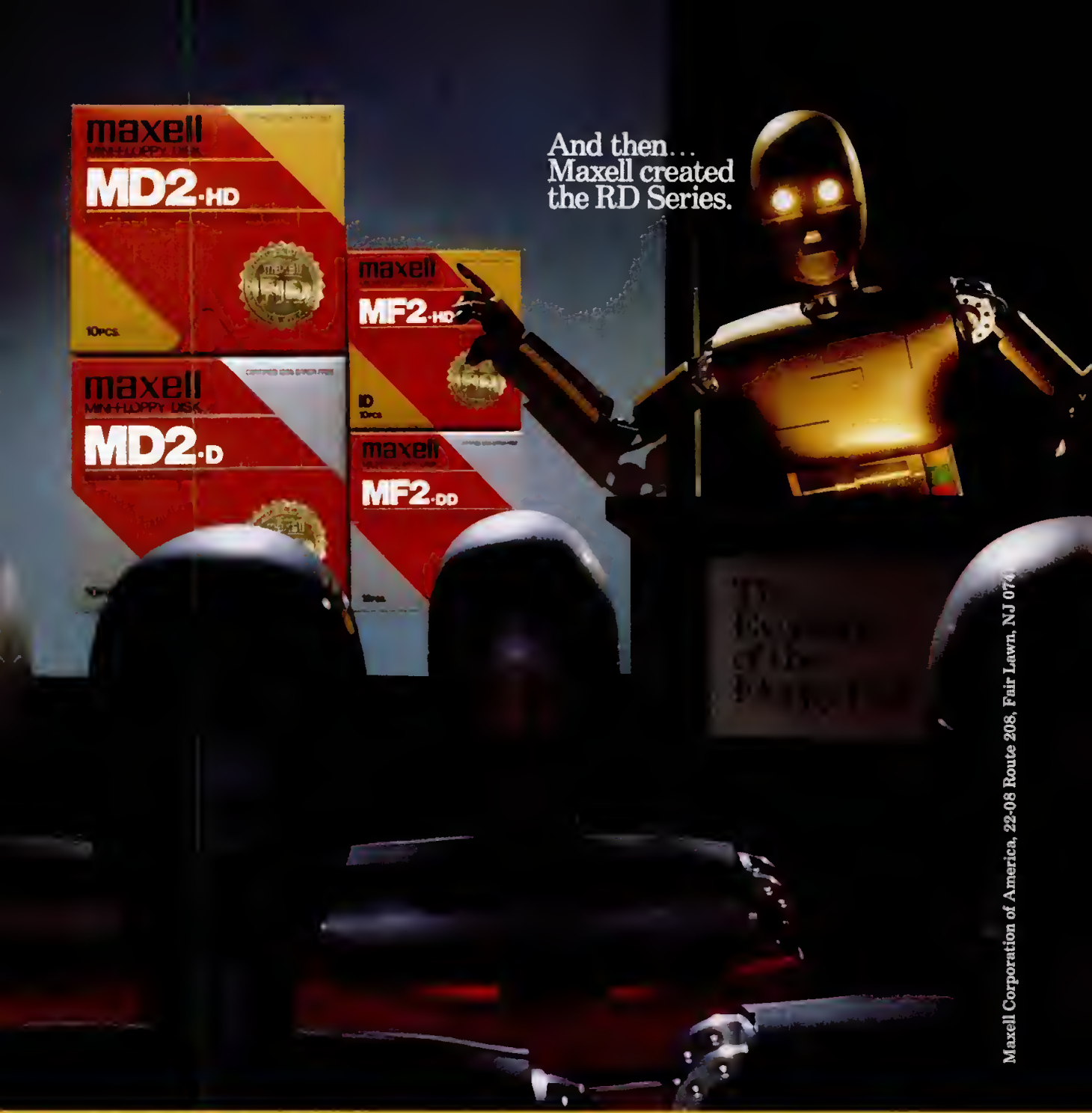
That kind of crude misapplication of PCs and PC software—the computer world's equivalent of the old saw that "when all you have is a hammer, everything starts to look like a nail"—means death for productivity. And this is hardly what the personal computer revolution is all about.

With that analysis, I've chosen two PIMs to use regularly. Many of the people who work with me have also begun to adopt these programs. That's not because I've proselytized for these two products or bludgeoned anyone into using them. Rather, it's because on some level we're *all* managers, and people quickly recognize that tools that help us manage better—even if we're managing only our own time and resources—are satisfying tools.

■ While we can adapt or stretch or turn inside out any of the PIMs available today, turning them into things their authors never intended, we wind up with an awfully blunt tool.

Next time I'll discuss those two products, how I use them, and how I think most business PC users can also benefit from using one or both of them. PC

CIRCLE 141 ON READER SERVICE CARD



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- 80386-25 CPU running at 25MHz
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- Zero wait state, Norton V.3 S1 rating: 29.7
- 1 MB memory (expandable to 8 MB using S1MM on board)
- 384K shadow RAM
- 1.2 MB floppy disk drive
- 1:1 interleave dual floppy/hard disk controller
- Ports: 2 serial, 1 parallel, 1 game
- Clock/calendar with battery backup
- 101-key enhanced keyboard
- AMI/Award BIOS
- CPU80387 math co-processor socket
- 8 expansion slots

386/20

$1,995

- 80386-20 CPU running at 20 MHz
- Zero wait state, Norton V.3 S1 rating: 23
- 1 MB memory (expandable to 8 MB using S1MM on board)
- 384K shadow RAM
- 1.2 MB floppy disk drive
- Dual floppy/hard disk controller
- Ports: 2 serial, 1 parallel, 1 game
- Clock/calendar with battery backup
- 101-key enhanced keyboard
- AMI/Award BIOS
- 80287/80387 math co-processor socket
- 8 expansion slots
- 64K cache memory system, $2395

Unbelievable CPU Prices.

386SX

$1,695

- 80386SX CPU running at 16MHz
- Zero wait state, Norton V.3 S1 rating: 18.7
- 1 MB memory (expandable to 8 MB using SIMM on board)
- 384K shadow RAM
- 1.2 MB floppy disk drive
- Dual floppy/hard disk controller
- Ports: 2 serial, 1 parallel, 1 game
- Clock/calendar with battery backup
- 101-key enhanced keyboard
- Award BIOS
- 80387SX math co-processor socket
- 8 expansion slots

286/20

$1,295

- 80286 CPU running at 20MHz
- Zero wait state, Norton V.3 S1 rating: 23
- 512K memory (expandable to 4 MB using 1 MB DRAM on board)
- 384K shadow RAM feature
- 1.2 MB floppy disk drive
- Dual floppy/hard disk controller
- Ports: 2 serial, 1 parallel, 1 game
- Clock/calendar with battery backup
- 101-key enhanced keyboard
- Phoenix BIOS
- 80287 math co-processor socket
- 8 expansion slots

286/12

$995

- 80286-12 CPU running at 12MHz
- Zero wait state, Norton V.3 S1 rating: 15.3
- 512K memory (expandable to 4 MB using SIMP on board)
- 1.2 MB floppy disk drive
- Dual floppy/hard disk controller
- Ports: 2 serial, 1 parallel, 1 game
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CIRCLE 163 ON READER SERVICE CARD

When We Challenged Our Competitors' Customers To Try PC Tools, This Was Their Answer.

A couple of months ago we gave users of Norton,™ Fastback,™ Sidekick,® X-TREE,™ Mace,™ and Disk Optimizer® a chance to upgrade to the number one selling utility package: PC Tools™ Deluxe.

A few days after the ads ran we started getting bags of mail, week in and week out, from customers anxious to get something better than what they already owned.

But why would they opt for PC Tools Deluxe as opposed to staying with what they already had? Simple. Because it's a far better product. It includes the best of what the others offer, and a lot more.

You see, PC Tools Deluxe is the only product to give you a DOS Shell, data recovery utilities, a hard disk backup program, and a desktop manager all in one box. Which means you won't have to learn the ins and outs of a whole bunch of products.

Just one–PC Tools Deluxe.

The only one with pull-down menus, full mouse support, and a windowed environment that lets you run up to 15 of our desktop applications at once.

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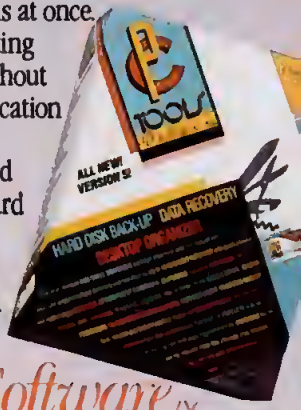

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■ WILLIAM F. ZACHMANN

OBJECT-ORIENTED TOOLS: PANACEA OR PROPAGANDA?

Object-oriented tools are valuable allies, but they are not the magical solutions to the "productivity problems" inherent in software development.

Object-oriented is well on its way to becoming one of the major industry buzz phrases. Object-oriented programming, object-oriented user interfaces, object-oriented databases, and even object-oriented systems are getting a lot of attention lately. Does all this add up to something really important, or is it just another case of too many gurus looking for the next neat new thing?

It reminds me of the story about the psychiatrist doing research on children's dispositions. A pessimistic child, put for an hour into a room full of toys, sadly ignored them. Asked why, he said he was sure they were going to be taken away after the hour was up. The optimistic child, however, enthusiastically spent her hour digging through a waist-deep pile of horse manure that filled the room in which she was studied. Asked why, she insisted, "Why, doctor! With all that manure, there's got to be a pony in there some place!"

There is a pony somewhere in all this "object-oriented" stuff. Like the missing pony in the story, however, it isn't necessarily as easy to find as some might think. Object-oriented software *is* going to be very important and very useful. It is not, however, the universal panacea that some of its overly enthusiastic proponents might lead one to believe.

Before looking at why, let's take a minute to make sure we are clear about what object-oriented software is—and how object-oriented approaches really differ from other ways of doing things.

Generally speaking, *object-oriented* refers to software (or hardware) systems that offer facilities for manipulating "objects" of one sort or another. The *Smalltalk*-influenced Apple Macintosh programming interface may be called object-oriented since it provides for the manipulation of objects like windows, dialog boxes, and menus. Similarly, the more recent OS/2 Presentation Manager API (application program interface) can be called object-oriented.

At the same time, but in a somewhat different sense, the graphical user interface provided by the Macintosh, the *Windows Presentation Manager, Open Look, DEC Windows,* and similar software may be called object-oriented. In these instances, the user manipulates objects by dragging down menus; opening, closing, and sizing windows; or disposing of objects by dragging them to the trash can.

Hypercard for the Macintosh is yet another object-oriented system. In this instance, cards, push-buttons, and stacks are objects that can be manipulated by the user both to move through stacks and to create them. By providing relatively high-level object abstractions to be manipulated, Hypercard makes it relatively easy for a nonprogrammer to create fairly complex "programs."

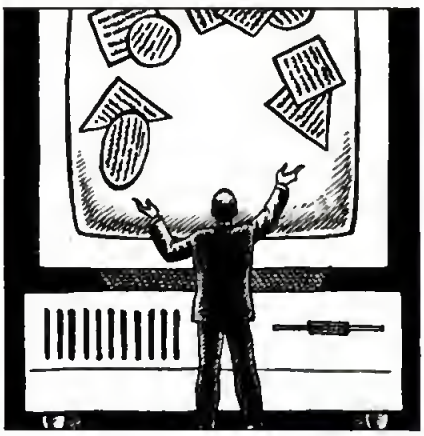

Illustration: Jean-Francois Allaux

Object-oriented systems like the unsuccessful Intel 432 microprocessor or the highly successful IBM System 38 (and the new AS/400) are so designated because they provide objects like processes that can be manipulated at the hardware level. Object-oriented database management systems, still largely in the research-and-development stage, make it possible to construct representations of very complex objects.

Perhaps one of the most promising developments is the emergence of object-oriented programming languages. One exciting instance is C++, originally developed at Bell Labs and now available from Zortech (Arlington, Massachusetts) in an excellent low-cost version for IBM and compatible PCs.

An extension of the C language, C++ illustrates some basic characteristics of an object-oriented system—its advantages and some of its limitations. It incorporates a capability that some consider an essential characteristic of an object-oriented system: it lets you define new types of objects, which may be derived from previous objects and thus may have characteristics in common with them.

BUILDING COMPLEXITIES The ability to create new objects (or new abstract data types, as techies sometimes call them)

■ WILLIAM F. ZACHMANN

that can "inherit" characteristics from previously defined objects can be a powerful tool. Essentially, it lets us build more-complex objects as constructions of less-complex objects.

The ideal object-oriented programming environment would make it possible to build the most complex systems imaginable out of progressive definitions of increasingly complex objects. In practice, however, there are two significant obstacles to creating a completely general environment for doing this.

First, no object-oriented software environment is completely general. The creation of objects (that is, the definition of new abstract data types) is always constrained by the basic "tool kit" of the language in one way or another. So while some sorts of objects may be relatively easy to create, others may be impossible.

Second, but even more important, programming and systems-development requirements in the real world often have an inherent complexity that does not lend itself to simplification through object-oriented approaches.

Every object-oriented system, in the end, only serves as a shorthand notation for what one wants to do with the system. Specifying the creation or movement of a window or a dialog box on a screen, for example, is really a kind of shorthand for all the specific things that must be done in order to manipulate the object.

As in fractal geometry, however, real-world problems have an annoying way of remaining complex even when the shorthand notation of an object-oriented system is available. If, for example, I require lots of items on the menu or need to create a complex graphic within the window, the programming task may still be considerable.

As object-oriented capabilities become more readily available, we simply move on to another order of complexity in the system tasks we undertake. This is not to say that object-oriented software is worthless. It permits us to do things that previously couldn't have been done at all. But it does not eliminate complex and difficult development tasks; it simply moves them to a higher level of abstraction.

So, while there is every reason to welcome and to use the growing array of object-oriented tools now becoming available, there is also every reason to expect that none of them individually—nor all of them combined—will "solve the productivity problems" in software development. That may not be good news for those who want a magical solution to their problems. It does mean, however, that good programmers and analysts can count on being in demand for years to come! PC

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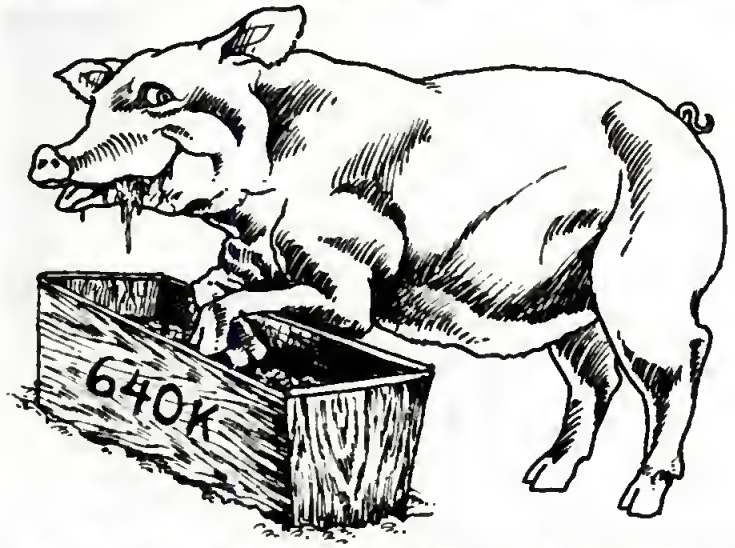

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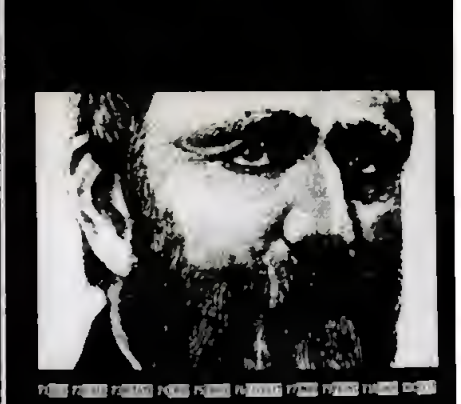

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■ STEPHEN MANES

BILL GATES: STRAIGHT TALK, WITH CHASER

Bill Gates is smart. Bill Gates is rich. Bill Gates is famous. But Bill Gates keeps speaking out on the PC industry issues that matter most.

You'll have to excuse me. I've got Bill Gates on the brain. Mention that you're moving to Seattle—by the time this sees print, I'll be chasing rainbows—and everyone asks the same question: "You going to work for Microsoft?" I've had to say no so often I've come to wonder whether Gates runs the Seattle Welcome Wagon, showering newcomers with shekels from his overflowing coffers.

In the Pacific Northwest, Microsoft now garners the "share-of-mind" heretofore reserved only for Boeing. Billionaire Bill is already something of a national hero; in his own realm he's a demigod. What other one-time programmer gets to appear on the cover of a regional magazine with his arm around the gargantuan shoulders of gonzo Seattle Seahawk Brian Bosworth for a brains-and-brawn-that-typify-the-Northwest-spirit civic-booster piece?

OK, so Gates is a genius. He's richer than anyone has a right to be. Rumor has it that when his spectacles refract his smoldering squints, women melt. Yet he dresses down and displays less hubris than your average programmer. It's depressing.

Technoids get especially irritated. Though a few see him as the ultimate vindication of their breed, the rest maintain their sanity by considering him the Gladstone Gander of codesmiths, a guy who just happened to get a lucky break or 87 ("Geez, I mean, he was into what, BASIC?") and woke up rich and famous. Programmers haven't exactly been wild about certain Microsoft policies—such as the price of the OS/2 developer's kit or the fib about how *Microsoft Windows* code would be pie to translate to the Presentation Manager. But then in olden times hackers were miffed at Gates for actually charging for software and criticizing pirates.

And then there's the checkered history of Microsoft applications, which have evidenced a certain sluggishness, not to mention something less than a Japanese obsession with quality control. *Microsoft Access* is notable mostly because it's visibly slower than any of its competitors. The horrendous second release of *Word for the Macintosh* was, according to one source, identical to the beta version whose dozens of bugs he'd reported weeks before. Microsoft's CD-ROM software should be called Lethargy Simulator.

STRAIGHT TALKER Despite all the good and bad reasons to knock Bill Gates, it's hard not to think highly of him. Maybe it's because he's the big-company executive who offers straight talk about the industry, something I realized at last year's Microsoft CD-ROM conference. Where Apple's John Sculley offered a terminally cute multimedia extravaganza touting a "vision of the future" in which a talking icon anticipated his every whim and responded to his voice, Gates stuck to issues like data compression and graphics standards and went out on a limb to predict that by year-end 1991, a $1,000 PC would include a CD-ROM drive. It was the difference between canned and fresh; it made you wonder whether Sculley knows what data compression is.

Illustration, Jean-François Allaux

NeXT's Steve Jobs has some of Gates's technical equipment and much of his experience, but there's always a slick of snake oil in his wake. Jobs's view of the future is always his machine of the present, be it a disk-intensive machine with just one floppy disk drive, or a high-style box with no floppies at all—a bit chauvinistic when you consider how many more computers are running Bill's software. Because software is Gates's main business, it's in his interest to cultivate as many hardware manufacturers as possible, so his view of the industry tends to cut a wide swath.

In fact, if there's someone willing and able to share a more expansive view of the industry than Gates, I'd be hard put to say who it is. He goes back to the beginnings of the personal computer industry. Unlike marketing-oriented execs, Gates plays at the leading edge of technology because he genuinely loves and understands the stuff.

When he talks about it, he sounds like a kid in a toyshop—most fascinatingly in the Sacramento PC Users Group magazine *Sa-*

■ STEPHEN MANES

cra Blue, which transcribed a talk that Gates had given to a user group confab last August.

"We finished our work on the 80486 some time ago," he notes, pointing out that the 80486 chip gains a great deal of its power not from clock speed, but from reducing the number of clock cycles per instruction.

Then comes what Gates calls "the really amazing thing": the idea that the coming 586 chip "will be able to work on multiple instructions at the same time"—in other words, "the average instruction will take less than one cycle." And you thought your new 386 machine was hot.

One obvious problem: fending off situations in which one instruction will produce a result the next instruction needs. "It's extremely tricky stuff," Gates says with glee. "It's a fun thing for us."

The "binary-level standard" is a concept Gates pushes hard. To explain it, he recalls the days when Microsoft BASIC was the first software standard—on the source-code level. Within limits, you could take BASIC code from one machine, type it into another and run it—this in spite of numerous incompatibilities among microprocessors, operating systems, and disk formats. Most current Unix standards, he points out, are for this same kind of source-level interchange. You can't just grab a program disk from one Unix machine, slip it into another, and expect it to work.

Which is precisely what you can do with a "binary-level standard" such as MS-DOS (and, if it ever gets off the ground, OS/2). They're designed to work across a huge range of Intel-based computers—take any program disk, and, with some limitations, it should run in other machines. The same holds within the Macintosh family (where Microsoft boasts 50 percent of the dollar volume of software sales). Gates sees this kind of compatibility as essential in the desktop market, and he's right.

Gates can even make a good case for OS/2 in language that doesn't sound like a press release: "Since Lotus can't get *1-2-3*, Version 3, to fit in 640K, how is it going to do Version 4? There's no new magic that's been invented for greasing stuff up to squeeze it in."

But Gates's great hobbyhorse is the graphic user interface. He thinks it's responsible for the Macintosh's success. He wants to see *Windows* or the Presentation Manager on virtually every PC. He subtly notes that "speed in execution" of graphics is a "problem which disappears as the hardware gets faster."

That's when you realize why people joke about the SLOW signs in Microsoft's parking lot. You recognize the chink in the armor, Mr. Software's one tragic flaw: Bill Gates is a hardware junkie. PC

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UNDERSTANDING NUMERICAL ANALYSIS

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Whether you are compiling a list of ten-digit prime numbers, computing the exact distance to Mars, calculating the average income of Sarasota residents, or predicting tomorrow's high temperature, you are working with numerical analysis. In its most general sense, numerical analysis is the realm of problems with numeric answers. These problems could be abstract (such as solving a differential equation) or mundane (such as finding the average test score). In many cases numerical analysis involves uncertainty—and this is the realm of statistics.

Statistics frequently involves formal procedures for applying rules of probability to arrive at numerical answers to questions. To the extent that probability is involved, the answers consist of "probabilistic results": predictions, estimates, and guesses. (The opposite is a deterministic result, which means that you've arrived at the answer exactly.) Thus, statistics helps people deal with uncertainty—both with uncertain *events*, such as the probability of winning a lottery, and with uncertain *knowledge*, such as the future rate of growth in the gross national product (GNP).

The advent of computers—first mainframes in the 1960s, then minis in the 1970s, and now PCs in the 1980s—allows for more exhaustive, accurate, and affordable numerical analysis and statistical research. And that's a certainty.

PROBABILITY The daily numbers player has only a vague idea of his chances of hitting the lottery, but the statistician can resolve this kind of question with a high degree of precision. For example, the Massachusetts Megabucks lottery calls for bettors to pick 6 numbers out of a possible 36. The calculation is a simple application of what is called a *combination:* there are 1,947,792 different combinations of 6 numbers; therefore the probability of picking all 6 correctly is 1 in 1,947,792, or 0.0000005.

Other forms of probability, such as weather patterns or the growth rate of the GNP, can be even more uncertain. In these

Illustrations, Libby Dorsett Thiel

types of cases, statistics becomes both an art and a science.

WHY USE STATISTICS? If statistics is an art that often supplies unclear answers, why is it so widely used?

- Since statistics operates with a formal set of procedures, the statistician has some control over what is considered and how it's looked at.
- Statistics gives us a way to measure our uncertainty. We lack definite answers, but we know which outcomes are most probable and how much confidence we can place in the predictions.
- The use of statistics guards against certain prevalent fallacies and biases. For example, suppose Jason does a terrible job on an important project and receives a reprimand from his boss. Then, the next time around, Jason does better. Suppose Martha does a superb job on a task and is rewarded, then she fares less well the next time. Does this mean that punishment works and reward doesn't? Not at all. Statisticians would explain both situations as "regression to the mean": extreme behavior on first measurement is likely to be replaced by less extreme behavior the next time around. This effect was first observed in the 19th century by Francis Galton, who found that very tall men have sons who may be taller than average but not as tall as their fathers.

Businesses forecast sales to help decide whether to build a plant or make a new product.

NULL HYPOTHESIS Since you can't always be right, statistical analysis requires considering what types of error are possible. Statisticians have to choose between the *null hypothesis* and the *alternative hypothesis*. The null hypothesis assumes that there is no difference between groups. Mistakenly rejecting the null hypothesis results in what analysts call a Type 1 error. The alternative hypothesis assumes there are differences between groups. Mistakenly rejecting the alternative hypothesis results in a Type 2 error.

Here are some examples:

In a court trial, four outcomes are possible: the defendant is justly found guilty, justly found not guilty, unjustly convicted (he didn't do it), and unjustly acquitted (he did, and beat the rap). The judicial system presumes a defendant is innocent unless evidence proves otherwise. A social scientist would call that the null hypothesis (there should be no difference between the presumption and the outcome unless there's information to the contrary). An unjust conviction, then, would be a Type 1 error. An uncalled-for acquittal would be a Type 2 error.

Some of the statistical analysis programs reviewed in this issue sometimes come up with wrong answers. In a regression analysis, if the program says it can't do the problem or if it gives a wildly incorrect answer such as a negative variance (which isn't possible), that's a Type 1 error. If the program gives a seemingly reasonable but wrong answer, that's a Type 2 error.

Unfortunately, statistical packages normally supply estimates only for the probability of a Type 1 error—meaning that the null hypothesis has been rejected by mistake. If, however, the null hypothesis has been assumed, the statistician will want to know the probability of having made a Type 2 error: of having failed to reject the null hypothesis when it should have been rejected. (Since the probability of a Type 2 error is inversely related to the size of your sample, it is particularly important to obtain this probability when the sample is small.) While no program measures it automatically for you, with a little work the probability of a Type 2 error can be obtained either from a specialized package or from one of the few standard packages that do make some provision for this type of calculation.

A third example underscores the importance of examining the numbers underlying percentage results. The table given below shows the probability of correct results in tests for the AIDS virus, where Reality inidicates whether the patients are actually infected and Results indicate whether the patients tested positive or negative.

		Reality: AIDS virus	Reality: No virus
Results	Positive	.99	.01
	Negative	.01	.99

Thus, 99 percent of those with the AIDS virus will correctly test positive, and 99 percent of those without AIDS will correctly test negative. Given these numbers, what would be the actual rate of false positives and false negatives if the entire U.S. population of about 250 million were tested? (In reality, a little less than 1 percent of the population has AIDS.) Using the percentages above, we now get these results:

		Reality: AIDS virus	Reality: No virus
Results	Positive	2,475,000	2,475,000
	Negative	25,000	245,025,000

If 2.5 million people have AIDS (1 percent of 250 million), in a 99 percent accurate test 2,475,000 will test positive for AIDS. Because there are so many more people without AIDS than with AIDS, 2,475,000 will falsely test positive. For less accurate tests or tests for even rarer conditions, false positives may equal or outnumber true positives. The moral: don't rely on percentages without taking into account the underlying numbers.

CAUSATION VS. CORRELATION Just because two things happen at the same time (correlation), one doesn't necessarily cause the other (causation). There is no form of statistical analysis that can supply you with any information about causation

FINDING THE RIGHT STATISTIC WITH STATISTICAL NAVIGATOR

Choosing appropriate statistical procedures is often crucial to successful research. Often you know which procedures you want to use, but what about those situations when you must do something new and you aren't sure which analyses are appropriate? Then you can turn to *Statistical Navigator*, an expert system that recommends the appropriate statistical procedures for a variety of situations.

Statistical Navigator asks you questions about your goals, your data, and your audience; it supplies help files for each question. Confidence factors can be used if you are not 100 percent certain of an answer. Based on your answers, it will recommend one or more suitable statistical procedures.

The questions help focus your attention on the crucial issues and tell you what you need to know in order to make a statistical decision. This is perhaps the most useful aspect of *Statistical Navigator*. Even when you disagree with its recommendations, using the program helps you clarify your thinking. People are generally not good at exhaustive searches of all possible alternatives, and you may find that *Statistical Navigator* will recommend procedures that are less obvious but more appropriate than your initial suggestions.

Statistical Navigator handles eight categories of statistics including such areas as exploratory data analysis, scaling and classification, multivariate regression and ANOVA, measures of association, measures of reliability, and descriptive statistics.

It prints a report that explains the reasoning behind its recommendations and compares the characteristics of each recommendation against your goals, data, and audience. The report contains technical references and names the statistical packages that implement each procedure; the program does not do statistical analysis itself.

It is a new program and it has a few weaknesses. Its coverage of statistics is not uniform. For example, it seems to cover reliability and causal analysis much better than it does analysis of time series. Sometimes it has less depth than would be desirable: while its recommendations differentiate multidimensional scaling, cluster, and factor analysis, it does not distinguish principal components from common factor analysis.

Overall, *Statistical Navigator* is very helpful as a practical tool for individuals who are not statisticians but need to do serious statistical analysis. It would also be handy in research institutes, academic departments, or agencies that evaluate statistical research.—**Grant Blank**

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through the mathematics alone. Some examples:

■ **There is no relationship, just an accidental statistical result.** The number of radios in Great Britain from 1924 to 1937 correlated highly with the number of mental defectives. In the late 1940s researchers found a positive relationship between the number of soft drinks sold during a week and the number of new cases of polio.

■ **The relationship is "caused" by some other factor.** The number of maiden aunts that you have positively correlates with the proportion of calcium in your bones (younger people tend to have more calcium and more maiden aunts). In New Hebrides there was a positive relationship between number of lice people had and their health (lice avoid feverishly warm bodies). There is a negative relationship between per capita consumption of ice cream and rate of juvenile delinquency (both caused by income, or lack of it).

Although some academic disciplines (genetics, social sciences, business) use a technique called *causal analysis*, causality can only be inferred based on the user's nonstatistical knowledge.

STATISTICS IN BUSINESS While the best-known polls are political polls, business polling and market research are more widespread. Companies want to know who uses products, how people like a company's products and competing products, whether service is satisfactory, and whether there's room for new products.

Unlike many other statistical techniques, polling gives you a real-world reality check. Eventually you'll find out who wins the election or whether a product succeeds. Over time, the checks improve polling techniques. We're unlikely to see a repeat of the 1936 *Literary Digest* presidential poll, which predicted that FDR would lose by a landslide (the polled magazine readers were comparatively less affected by the Depression and less likely to prefer Roosevelt).

FORECASTING Real-world checks benefit the area of forecasting, too. Gains have been smaller here, however, partly because forecasts look ahead several years, during which time many events can intervene. Common forecasts include the unemployment rate, the inflation rate, and the growth rate of the GNP. Businesses forecast sales to help decide whether to build a new plant or make a new product. Local governments might make forecasts of the population of school-age children in their districts when deciding whether to

build a new school or sell an old one.

In any of these cases, decision makers can end up with either a Type 1 or Type 2 error, and these errors can be very expensive. A town might build a $10 million school that turns out to be unneeded (a Type 1 error, since "do nothing" equates with the null hypotheis); conversely, it might fail to build a school that's desperately needed (a Type 2 error). At any given time, it is the weight allotted to the costs of these two kinds of errors that appears more important than a forecast made by a statistician. This may be especially true because statisticians are no better than nonstatisticians in predicting unique events, such as the formation of OPEC and the rapid rise in oil prices in the early 1970s. These events are important since, for example, an unforeseen rapid rise in oil prices might make it impossible for a new factory to generate a profit even if all productivity and sales forecasts were accurate.

EVALUATION One important use of statistics is evaluation: Does a new program, new drug, or new medical treatment work better than the standard one? These studies are often associated with government programs or regulations. For example, the Food and Drug Administration will not allow a company to market a new drug until, using acceptable statistical procedures, the company can show that the drug is both safe and effective. Business applications consider the best types of training and whether different types of employees need different types of training. These issues include standard statistical procedures (comparison of two averages or two proportions) and questions of sampling. If the employees to be trained in the evaluation are a biased sample of your employees, then the results may not apply to all employees.

Most analysis techniques can be found in general-purpose statistical packages. You'd need special packages for such areas as survival analysis or growth curve analysis, as well as for designing experiments and choosing sample sizes. Evaluations are very difficult: essentially, you are asking what would have happened under circumstances different from those actually present. There are many ways to estimate this kind of outcome, including control groups and forecasts; unfortunately, none of them are perfect.

QUALITY CONTROL Many people believe that Japan's industrial success stems from paying close attention to quality control. While there are nonstatistical aspects to that success, the current emphasis is on statistical quality control, and the person who convinced the Japanese of its importance, W. Edwards Deming, is a statistician. Statistics are used in everything from designing quality control studies to determining whether the output is in control (whether the amount of variation in the output is small compared to a particular guideline).

One aspect of statistics is evaluation: Does a new program work better than a standard one?

HIRING AND FIRING Testing often helps to determine who gets hired, trained, evaluated, promoted, and fired; statistical tools help psychologists design tests that are reliable and valid. Tests have to be accurate to ensure fairness to the employee and the company—and to keep the company on solid legal grounds when personnel decisions are challenged.

LITIGATION SUPPORT There are many areas of the law that virtually require the use of statistics in helping to determine whether a violation of the law has occurred. These include employment discrimination, deceptive advertising, antitrust issues, jury selection, damage determination, and earnings forecasts.

Most litigation-related statistics concern analysis of already existing data, but some issues (deceptive advertising) may call for new data collection by means of surveys or experiments. If you're analyzing existing data, standard statistical packages are likely to handle almost everything.

DIAGNOSTICS Finally, you need diagnostic procedures for your analysis to see if there are failures of the underlying assumptions, and if so, how serious. Regression diagnostics, including measures of influence and collinearity, are the best known.

USE WITH CAUTION Software in the hands of unskilled users can be dangerous. Some numerical analysis packages are just too easy to learn: they allow people who know nothing about their data, nothing about statistics, and very little about their substantive area to obtain results easily. Although PC-based programs have the advantage of spreading statistics to a broader base of users, they have the disadvantage of providing power beyond what some people can handle.

PCs VS. MAINFRAMES The first commercial statistical software appeared in the 1960s. Often just collections of separate routines, these packages required mainframes and were slow, hard to use, and often inaccurate. Quality improved in the 1970s, although there were still only a half-dozen general-purpose programs. Now there are hundreds of stat packages for the PC. Some follow mainframe models, and there are numerous special-purpose packages that don't exist in mainframe or minicomputer versions because the mainframe market is too small relative to the cost of developing mainframe software. PCs offer other advantages as well: generally superior technical support, overnight bug fixes (sometimes), better graphics (especially dynamic graphics such as scatter plots), and faster throughput. However, PC software often restricts the size of the data sets you can analyze.

After 20 years of working with numerical and statistical analysis software on

computers of all sizes, I've developed a vast preference for analysis on the PC, although I still maintain a mainframe account for big data sets. On the PC, I work with three general-purpose packages and occasionally use five others, plus a number of special-purpose programs. Unlike your experience with mainstream applications (word processing, spreadsheets), where one program usually fulfills all your needs, you'll probably find that no single program has all the features you want.

WHAT'S INSIDE To serve the needs of scientists, statisticians, and technical professionals for specialized software, we've devoted this issue of *PC Magazine* exclusively to numerical analysis. We're focusing on three key areas:

- *Statistical analysis*. More than 200 packages exist for PCs. We culled the field to 30 major programs in two categories: basic statistical analysis, covering descriptive statistics, regressions, variance analysis, discriminant analysis, cross-tabs, nonparametric tests; and advanced statistical analysis, with additional procedures, programming features, and the ability to handle bigger data sets. Additionally, we examined another 19 specialized software packages falling into the following categories: forecasting, econometric modeling, and special interest.

Each program was tested for suitability on five tasks representing common, real-world applications: quality control engineering, biological research, marketing research survey, social science research, and forecasting.

- *Scientific graphing*. These ten programs handle larger data sets and contain graph types unavailable in most mainstream presentation graphics programs. We also discuss the abilities and limits of the better mainstream graphics programs, such as Micrografx's *Graph Plus* and *Microsoft Chart*.
- *Equation solvers and mathematical toolboxes*. These 16 programs, including *MathCAD*, *Eureka*, and *TK! Solver Plus*, serve as free-form electronic slates to create and solve equations that would throw *1-2-3* into a tailspin. Since few mainstream word processors can digest equations, some programs also offer passable manuscript printing capabilities.

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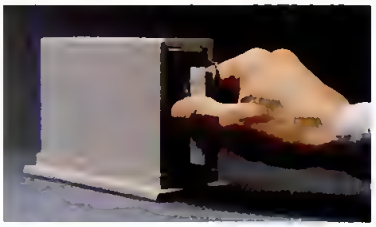

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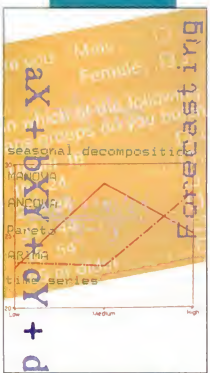
STATISTICAL SOFTWARE FOR THE PC

TESTING FOR SIGNIFICANCE



No matter what your needs, there is a PC-based statistical package just right for you.

Statistics are the stuff that decisions are made of. But when it comes to choosing a stat package, suddenly statistics don't make the decisions; they create the need for them. Unlike spreadsheets, word processors, databases, and other general-purpose software tools that tackle their work with similar conceptual frameworks, each stat package plays by its own set of rules. Of the packages we looked at in these reviews, you'll be hard pressed to find any two that are alike in their "look and feel" or methodology.

Because one PC stat package is so different from another, you've got to do a bit of self-analysis before you attempt any statistical analysis. Some users find wrestling with the gargantuan programs, typically descended from mainframes, worth the investment. These products offer a statistical smorgasbord of functionality. Others hone in on a more modest set of procedures contained in a more manageable product. Still others with highly refined special interests may opt for a dedicated product that does one thing, such as financial forecasting, and does it well. Some want to take advantage of the PC's marvelous capacity for graphics and graphical interfaces; others want their packages clean, lean, and portable.

Our early research uncovered more than 200 commercially available stat packages for PCs. (There are several hundred shareware packages as well. See the sidebar "Shareware and Free Statistical Software.") We chose to review 48 packages that cover a broad range of statistical applications. The packages examined in this issue indicate the scope of statistical software; they are not intended to be an exhaustive list. What they clearly indicate is that there are stat packages out there to meet your needs quite well.

Pigeonholing the products gave us a clearer perspective of the broad statistical market. Our categories—Advanced, Basic, Econometric Modeling, Forecasting, and Special Interest—suggest the general tenor of each program.

The Basic statistical analysis tools cov-

er a variety of fundamental statistical procedures: descriptive statistics, regressions, analysis of variance, discriminant analysis, cross-tabs, nonparametric tests. Some packages offer considerably more depth than others. I like to think of this category as the Stat 101 course for the PC. Our Advanced statistical analysis category includes many of the leading full-powered stat packages. These are large, comprehensive programs that load on the extra statistical procedures, data handling, and programming features.

We also took a detailed look at Forecasting and Econometric Modeling packages, in part because of the appeal this slice of statistics has to our readership. The forecasting packages are masters at emphasizing trends over time. They offer techniques to look at and adjust the past to model the future. While some of the general-purpose stat packages can produce forecasts using time-series analysis, they lack the nifty automatic model-selection capabilities of dedicated forecasting programs.

Finally, in order to answer more-streamlined needs, we looked at a sampling of Special Interest software, including two quality-control engineering packages, masterful at separating the "vital few" from the "trifling many" in a data set. And we evaluated some packages that exist for a specific statistical routine, such as *A-Cross*, which handles only cross-tabs, and two packages that handle only survey data.

HERE TODAY, REVISED TOMORROW "Stat packages are curious," says Gerard Dallal, one of our reviewers and a statistician at Tufts. "The players stay the same, but the winner keeps changing." Most of the key players are in constant revision. Older packages that failed to get a face-lift, such as *Sigstat* and *NWA Statpak* are quickly falling from grace. At least one relatively new package—*CSS*, from Statsoft—though a bit uneven in its present incarnation, is projected to improve tremendously by the next go-round. The statistical software industry is fluid—that's good for product evolution and terrible for making a purchase decision. You'll need to read these reviews through a crystal ball since a good portion of the products reviewed here promise revisions in upcoming months.

Sadly, the revisions aren't only to accommodate cosmetic improvements and tack on more features—bugs are as common in the PC stat package landscape as they are on a June day in Maine. Considering the myriad types of data that users run through these programs, it's easy to understand how one particularly oddball data set might cause unpredictable results. Some on-the-ball vendors give you a bug fix overnight. The best of the bunch will notify the entire user base, but most deal with a resolved bug as a single-user issue. Some less conscientious vendors mutter "Oh yeah . . . we know about that one" under their breath and hope you don't call back.

Bugs are as common in the PC stat package as they are on a June day in Maine.

IN STATS WE TRUST? When you get right down to it, the phrase *easy-to-use statistics*, like *military intelligence*, is an oxymoron. Statistical packages, especially PC-based, menu-driven ones, can look deceptively simple. Those of us intoxicated with our success in mastering word processors, spreadsheets, and databases may be led down a path of roses by a sweet-smelling stat package. These packages can give the appearance of doing meaningful work, when the results are nonsense.

Here's a case in point: when we developed the biological research task in our testing script (see "A Day in Five Lives: How We Tested Statistical Analysis Software"), we ran our analysis of variance on *RS/1*, Version 12.1, and sent the answers to our unsuspecting reviewers. Only when none of the reviewers could match our answer did we discover the bug in the *RS/1* algorithm. (*Editor's note:* RS/1*'s vendor, BBN Software, is aware of these bugs and says the algorithm errors will be corrected in Version 4.0, which is due to be released in the first quarter of 1989.*) Read these reviews and you'll see that *RS/1* has plenty of company.

In an optimal world, it would be nice to run a few known-quantity sample analyses through a program and compare the results before you purchase. Short of that, if you don't have an in-depth statistical background, it's important to choose a package that emphasizes tutorials and examples and offers a huge dose of customer support. All of our reviewers have reported their findings on these matters. Of the large packages, *SPSS/PC+* has an excellent as well as leviathan series of documentation. *Minitab Statistical Software* is a more modest program that doesn't skimp on documentation either.

One often-overlooked feature of stat packages is the presence of good diagnostic tools. If a program doesn't provide you with an array of tools to test and validate your assumptions, your results may be shaky. Some programs make routine checks of your variables and inform you that your results may be problematic. Other, more-sophisticated diagnostics can help you to ascertain whether a particular statistical technique is the best, given the nature of the data. Both the *SAS* and *SPSS/PC+* programs give you the tools for testing your assumptions; those with programming facilities let you handcraft sophisticated diagnostics of your own.

DEPTH VS. BREADTH Stat packages lend themselves well to the old toolbox analogy. There's the $10 hammer, screwdriver, and pliers set. You build the procedures you need using the basic tools. For example, many of the programs we looked at didn't have reliability procedures, but these could be hand-built using a series of tests. *Minitab Statistical Software* is a relatively simple program, but because of its macro and looping features, you can easily add missing functions. People who like to do it themselves or those on a shoestring budget may enjoy this approach. The big players—*SPSS/PC+*, *SAS*, and *BMDP/*

PC—offer the $100,000 toolkit, so when you need a Number 12 long-handle Torx driver, it's there.

The more-modest stat packages tend to be fine if you aren't too ambitious or too novel. Generally, they're heavy on descriptive statistics and often have procedures for only a subset of statistical analyses. They tend to lack robust data-management capabilities, often don't support publication-quality graphs, and often skimp on important, but easily overlooked, features fundamental to any reasonable analysis, such as the ability to import nonnumeric data.

Smaller, more vertical packages tend to be easier to use, and logically so. The full-blown area of statistics is complex, and many different pieces add to the complexity. Someone who does one thing, like time-series analysis, over and over will have an easier job than someone who needs to do everything once.

An attractive middle-road solution to the depth vs. breadth dilemma is a modular approach. *SPSS/PC+*, *SAS*, *NCSS*, *CSS*, *RS/1*, and *BMDP/PC* all offer base products that handle a good amount, to which you can add on various modules. Bear in mind, however, that a company's schema for deciding what to include and what not to include in the base package is not always judicious. Some, like *Systat*, make obvious delineations: you can buy it standalone or bundled with *Sygraph*, the graphing component. In addition, the vendor has additional offerings, from a low-cost stat package for the nonstatistician, to survival analysis modules. Others, such as Scientific Computing Associates, offer a slew of stat products, collectively called the *SCA Statistical System*, that can be mixed and matched based on your requirements.

General packages designed to make statistics attractive to the world at large are also making a mark. *Exec*U*Stat* attempts to make statistics a part of everyday business by combining statistical functions with, of all things, address-book, calculator, and calendar accessories. Maybe it's for the businessmen who want to know the mean cost for lunches this month?

DATA-HANDLING TOOLS Whether it's a $10 toolbox or the full-blown workshop, incorporating computational tools for performing statistical analysis is only a portion of what a good package should do. It doesn't matter how well executed an ANOVA (analysis of variance) routine is if you can't import or export the data and massage it in the interim. The supporting players—data import and export, data editing, data listing, data generation, and finally data management—are equally important.

Data handling and management are what separate the wheat from the chaff. The best packages let you interactively involve yourself with the data, using a full-

The best packages let you interactively involve yourself with the data.

screen editor. They include techniques for data verification: checking for ranges and valid values. They also include comprehensive data-listing capabilities, allowing the user to select a conditional subset of cases from the data set.

To be truly useful, a package should have robust data-transformation and -manipulation techniques. You should be able to insert, join, sort, transpose, and split data sets. You should easily be able to transform a data set, using a variety of functions and equations, and optimally you should be able to watch your data in a spreadsheetlike display as it undergoes the transformation.

The best packages can recode variables and deal with missing values through imputation. Other simple courtesies, such as the program's allowing you to name a variable MALES instead of VARIABLE 1 and allowing you to import nonnumeric data, should be, but weren't, de rigueur features included in stat packages.

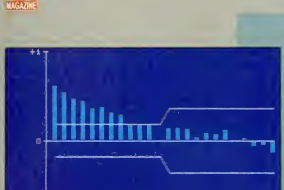
Most of the packages fell short of meeting these data-manipulating requirements. In addition to their many documented limitations, we stumbled across a potpourri of undocumented program limitations. For example, *SCA Statistical System* couldn't import more than 72 columns, and *Turbo Spring-Stat* had a problem with password routines. And just where you'd least expect it, unnerving limitations appear. For instance, the powerful *SPSS/PC+* handled descriptive statistics with only three places after the decimal point. Using the tiny numbers in our engineering data, our reviewer had to scale the data and then rescale it to get a meaningful answer during testing.

The results of poor data handling are the Paul Bunyan stories of the stat community. A classic case involves a data set of about 2,500 cases that produced a series of regressions indicating a startlingly high frequency of sex between married subjects in a 4-week period. A close inspection of the data revealed that four cases were reported as 88 times per month. It was discovered that 99 was the "missing value" code, and it was eventually suggested that the keypunchers, entering 8s instead of 9s, were the culprits. When the "big four" cases were deleted from the regressions, the signs on all the crucial coefficients changed. A few data-entry errors were driving the regressions.

Another famous tale of bogus data collection is in the recording of cat temperatures. It seems a couple of the felines in this study were dead—a factor that seriously affects body temperature. "In statistics, you're looking for the structure and the usual," says Philip R. Burns, a statistical analyst at the Vogelback Computing Center of Northwestern University, "but you need to have facilities to look for the unusual as well."

A TYPIST OR A MOUSE? The raging command versus menu debate is no different with stat packages than with other application areas. Menus guide the novice and the casual user through an analysis in an organized fashion. While this method can limit the flexibility of the program, the vendor is making a series of intelligent decisions for you.

Statistical Analysis Glossary



***ESP* graphically displays the results of an auto-correlation.**

This example of a cross-tabulation table was produced by *Crunch*.

ANOVA Analysis of variance (ANOVA) tests hypotheses about differences in the mean values of one variable across two or more groups.
Example: You could use ANOVA to determine how the mean of employees' salaries varies across departments.

ARIMA and ARMA Auto-regressive moving average (ARMA) and auto-regressive integrated moving average (ARIMA) models are two popular ways of characterizing the changes in one variable over time. These models are used for time-series analyses.
Example: Use ARMA or ARIMA models to show how the sales of some item change over a period of time and to forecast future sales based on past performance.

● **Auto-correlation** Auto-correlation measures the degree of association among the values of a single variable measured at different times.
Example: Measure the sales of an item every month and use auto-correlation to show how closely monthly sales figures correspond.

Canonical correlation Canonical correlation measures the degree of association between two sets of variables.
Example: Math and verbal test scores might be one set of variables, while such factors as education and experience form the second set. The second set of variables would be used to explain the first set.

Cluster analysis Cluster analysis groups similar variables and observations together, cutting down the number of variables you have to work with.
Example: If one person is responsible for a number of tasks and performs several of them well, cluster analysis could determine whether these tasks can be grouped together as a single variable.

Correlation A correlation measures the degree of linear association between two variables at a specific time.
Example: Correlation could determine the degree of association between salary and length of employment.

● **Cross-tabulation table** A cross-tabulation table displays frequency counts in groups formed by the values of two or more variables.
Example: Use a cross-tabulation table to show how many females and males are working in each department of your company.

Data transformation Data transformation is the process of applying mathematical operations to variables. Transformations involve arithmetic operations like addition and subtraction; exponential, trigonometric, and probabilistic functions; and other operations, such as lagging data cases.
Example: You want to compare employee salaries based on annual figures, but your office includes both full-year and seasonal employees. You can adjust their annual salaries to reflect the number of hours they actually work by using a data transformation.

Dependent variable A dependent variable is an unknown quantity—a variable you're trying to predict or explain.

Discriminant analysis Given two or more groups of data, discriminant analysis finds a set of weights that allows you to classify people or things into groups.
Example: By knowing someone's voting patterns, you may be able to classify that person as a Republican or Democrat.

Factor analysis Factor analysis techniques use correlations (or similar measures) to find similarities among variables or observations. The intent is to reduce the number of variables while retaining as much of the original information as possible.
Example: See *cluster analysis* (factor analysis and cluster analysis are often used for similar purposes).

Independent variable An independent variable has a known value and is used to explain or predict dependent variables.

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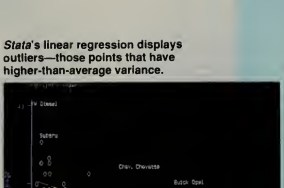
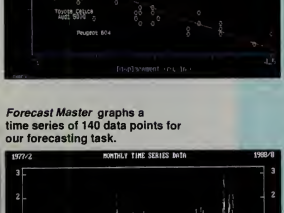
Stata's linear regression displays outliers—those points that have higher-than-average variance.



Forecast Master graphs a time series of 140 data points for our forecasting task.



Log-linear model A log-linear model tests hypotheses based on a cross-tabulation table, using a notation similar to that for analysis of variance models.
Example: You go on an employee picnic and a number of people get sick. Having determined who got sick and what foods they ate, you can use a log-linear model to determine which food was the most likely cause of the sickness.

MANOVA See *multivariate analysis of variance*.

Multidimensional scaling Multidimensional scaling attempts to find groups of variables or observations that are of similar importance in your analysis.
Example: Use multidimensional scaling to determine the ways in which one city is similar to another, and which factors are most important.

Multivariate analysis Multivariate analysis involves sets of measurements on two or more dependent variables.

Multivariate analysis of variance Multivariate analysis of variance (MANOVA) tests hypotheses about differences in the mean values of several variables across two or more groups. These variables are weighted, using discriminant or canonical analysis, to find the maximum differences among groups.
Example: Use MANOVA to determine how the mean of employees' salaries and length of employment varies across departments.

Nonparametric methods Nonparametric methods encompass a wide variety of techniques that make limited assumptions about the statistical distributions of data. Parametric techniques, by contrast, make specific assumptions about statistical distributions.
Example: You have two sets of test scores, one for males and one for females, and you want to determine whether one group scored higher. If both sets of scores follow a standard distribution (a bell-shaped curve), you might use a t-test to compare the two sets. Otherwise, you would use a nonparametric test to compare the scores.

● **Regression** Regression measures the correlation between a single variable (the dependent variable) and a set of independent variables.
Example: A regression would describe a salary level based on such factors as education, previous employment, age, and marital status.

Reliability testing A good survey will include several questions that are trying to get at the same point. Reliability testing checks that all answers to such questions are consistent with one another.
Example: The ten political questions in our social science research task examine whether people feel they can be politically efficacious in the world. Reliability testing would determine whether all questions were answered consistently.

Repeated measures design A repeated measures design compares a group of subjects in terms of some variable, several times (for instance, with respect to an ongoing treatment). A paired t-test is a simple example.

Scatterplots A scatterplot is a graph on which observations are plotted with respect to two variables.
Example: You could produce a scatterplot of employees' salaries based on their length of employment in the company.

Survival analysis Survival analysis tests hypotheses about data based on life expectancy, waiting time, or elapsed time until a specific event occurs.
Example: Survival analysis could be used to predict how long your computer will keep working, based on existing data for PC life expectancy.

t-tests A t-test examines hypotheses about differences in mean values between two groups. A paired t-test compares two sets of measurements of one variable involving the same subjects.
Example: A paired t-test could be used to test the hypothesis that iron supplements increase the red blood cell count of anemic individuals.

● **Time-series analysis** Time-series analysis models the change in one or more variables over time. ARIMA is an example of a time-series analysis.

A Day in Five Lives:
How We Tested Statistical Analysis Software

We explored a number of options before choosing a testing model for these statistical analysis packages. The "could have" scenarios are plentiful. We could have gone into the literature and culled a few salient data sets to run on the programs. We could have turned the programs over to statistics mavens, giving them carte blanche to do their thing. We could have investigated how fast the packages perform, although most of us agree that this is not a statistician's primary concern. Ultimately, in order to ensure that our reviewers look at a statistical package the way a variety of users might, we devised a test we call "A Day in Five Lives."

The test is really a series of five mini-scenarios, each detailing a real-life task. Together the scenarios determine how well these packages stack up—not to a series of textbook tasks, but to a series of real-life situations in a number of application areas. We modeled our tests on five areas:

- **Task 1: Biological research**
- **Task 2: Marketing research survey**
- **Task 3: Social science research**
- **Task 4: Forecasting**
- **Task 5: Quality-control engineering**

Each task requires the reviewer to conduct a number of different analyses and data-handling exercises. Our reviewers received ASCII data to import into their packages: sometimes field-delimited ASCII, sometimes free-field. They also received the data in .WK1 file format and tested to see whether their packages could import it in this format as well. Often the reviewer had to transform the data or use the statistical package to perform data cleaning.

Our overviews of the five tasks, presented in sidebars throughout this statistics blockbuster, will give you some idea of the scope of our testing.

—Robin Raskin

A poorly designed menu interface will force you to specify everything afresh each time you run an analysis. The best of the crop record the history of your menu sessions and let you run them again or modify them, not unlike communications programs that create scripts by watching you log on. *NCSS* bridges the menu/command rift by offering some cleverly designed "panels." You use the panels to build up procedures that can be saved and reused as a sequence. *SPSS/PC+*, a masterful record keeper, keeps not only a log of your session with diagnostics but also a listing of output from the program as it runs.

Command lines are for those who like raw power. There's less overhead and more flexibility. Many command-oriented programs are available on numerous platforms. If you use different environments regularly, it's a wise route to go. Some, like *Minitab Statistical Software* and *Microstat II*, successfully use command-driven routines without requiring that you hold a Ph.D. in statistics, but most require you to do a good amount of coursework.

Those with dual control systems, such as *SPSS/PC+*, *SAS*, and *Stata*, let the user choose between a command line and a menu—an admirable approach. *P-Stat* offers an optional MENU add-on to circumvent the complicated syntax of its command language.

Whether the stat package you choose is menu driven or command driven, you'll want it to have a program language to automate routines and do things your way. Packages like *RS/1* and *Minitab Statistical Software* use an English-like syntax that most users can master quickly. Others, like *BMDP/PC*, require multiline routines, à la mainframe, and are more demanding.

GRAPHICS One of the best reasons to use a PC stat package is graphics. The graphics components of these packages are evolving the most rapidly. Most of the major products are offering more types of analytical graphs, as well as better support for publication-quality graphs. The better packages provide control over annotations and labeling; they support high-quality output devices and multiple fonts. More and more packages are including star charts, box charts, and an array of 3-D graphics to their repertoires.

Most exciting is the abundance of new graphical techniques being used on PCs in a practical fashion. These techniques have all been around for a while, but PCs can, for a few thousand dollars, make them useful. Two particularly exciting techniques—scatterplot matrices and 3-D rotating point clouds—are PC inventions, executed beautifully on *NCSS* and *Systat*. Brushing, a technique that lets you highlight a series of data points in one scatterplot on a scatterplot matrix and have them automatically highlighted in the others, is used in *NCSS*, and we expect other vendors will adopt it as well.

SON OF A MAINFRAME When it gets right down to it, mainframes are still driving PC stat software, and economics is behind it all. In academic institutions you're still frequently stuck with mainframes, because it's less expensive to spend $6,000 on a mainframe package than to outfit each student with a PC and a stat package. Tradition (not to mention large data sets) also plays a strong role in keeping students on mainframes. As networks improve and as an equivalent amount of money buys more technology, things will change.

A year ago Gerard Dallal grew curious about whether there was a need for the statistical community to review PC stat packages. Hadn't everyone already made a choice, he wondered? In 1987 Dallal sent his questionnaire to U.S. university departments offering degrees in statistics. Forty-eight of 115 responding departments said they had not formally adopted a package. Among those that had adopted a package, the vast majority opted for PC versions of good old mainframe standards—*SAS*, *SPSS/PC+*, *BMDP/PC*, and *Minitab Statistical Software*. Of all the

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packages designed specifically for PCs, only *Statgraphics*, *Systat*, and *Gauss* made any inroads.

Many academics complain bitterly about the PC implementations of mainframe products. The PC package typically has a subset of functions on the mainframe, and it's often difficult to remember what's included in the subset. You may spend hours with a routine on the PC to find out that the mainframe version has a different routine that will halve the time. Smaller companies with smaller products may be able to implement new techniques faster. Certainly the graphics in *NCSS* and *Systat* make a good case in point.

SAS, which made its big splash in the 1970s, wins the mainframe act-alike con-

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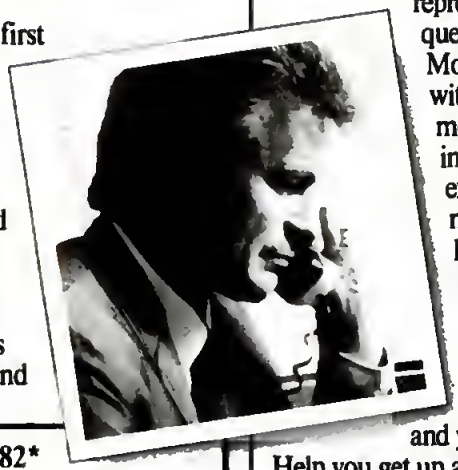

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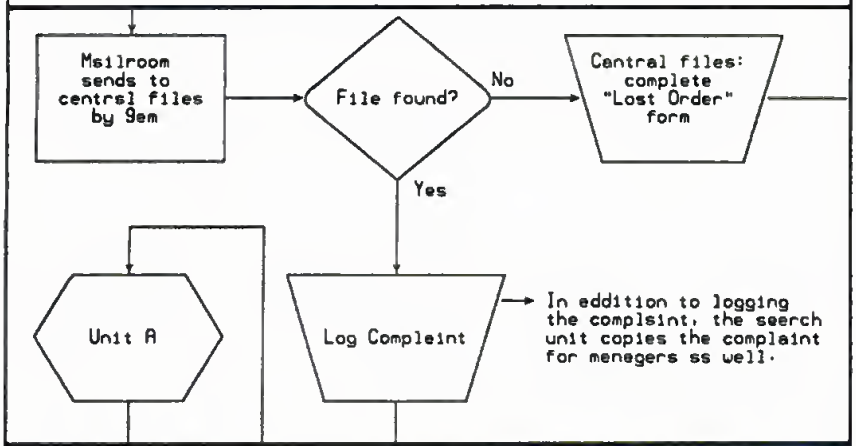

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STATISTICAL ANALYSIS

test, but the PC version is difficult to learn. *SAS* on the PC can create a window to the mainframe, can port data sets in *SAS* format through its proprietary communications, and has more data management facilities than the other large packages. However, many statisticians feel the program has not remained current in its statistical procedures. *SPSS/PC+*, weighing in at 42 disks (27 for statistics and 15 for supplementary graphics programs), requires about 12MB and is best used on a dedicated PC.

Despite its largeness, *SPSS/PC+* has catered to the PC community by offering solid documentation, tutorials, publication-quality output, and a well-implemented menuing system. Not all of the mainframe functionality is included in *SPSS/PC+*, and some of the commands work differently than on the mainframe version. *BMDP/PC*, once the king of the roost, has not attended to cosmetic enhancements. Its results are reliable, but its use has fallen off dramatically.

LOOKING TO THE FUTURE Computers are driving new statistical techniques as well as automating old ones. The next wave of packages will allow statisticians to determine the reliability of their data and their assumptions more accurately, essentially because the computer can do the intensive calculations that were previously only approximated. One promising new technique, bootstrapping, involves using the computer's number-crunching capabilities to construct artificial data sets that test the reliability of statistical inference. The technique was invented by Bradley Efron, a statistician at Stanford University.

Undoubtedly, expert systems, already a part of forecasting packages, will play a big role in widening the circle of users. For the rest of us, there's no better stat package than one that contains software-coded decisions made by a knowledgeable statistician. I'd like to be able to sit at my spreadsheet and ask it, in English, "Is there really a big difference between men's and women's salaries in this data?"

—Robin Raskin

Robin Raskin is a contributing editor of PC Magazine.

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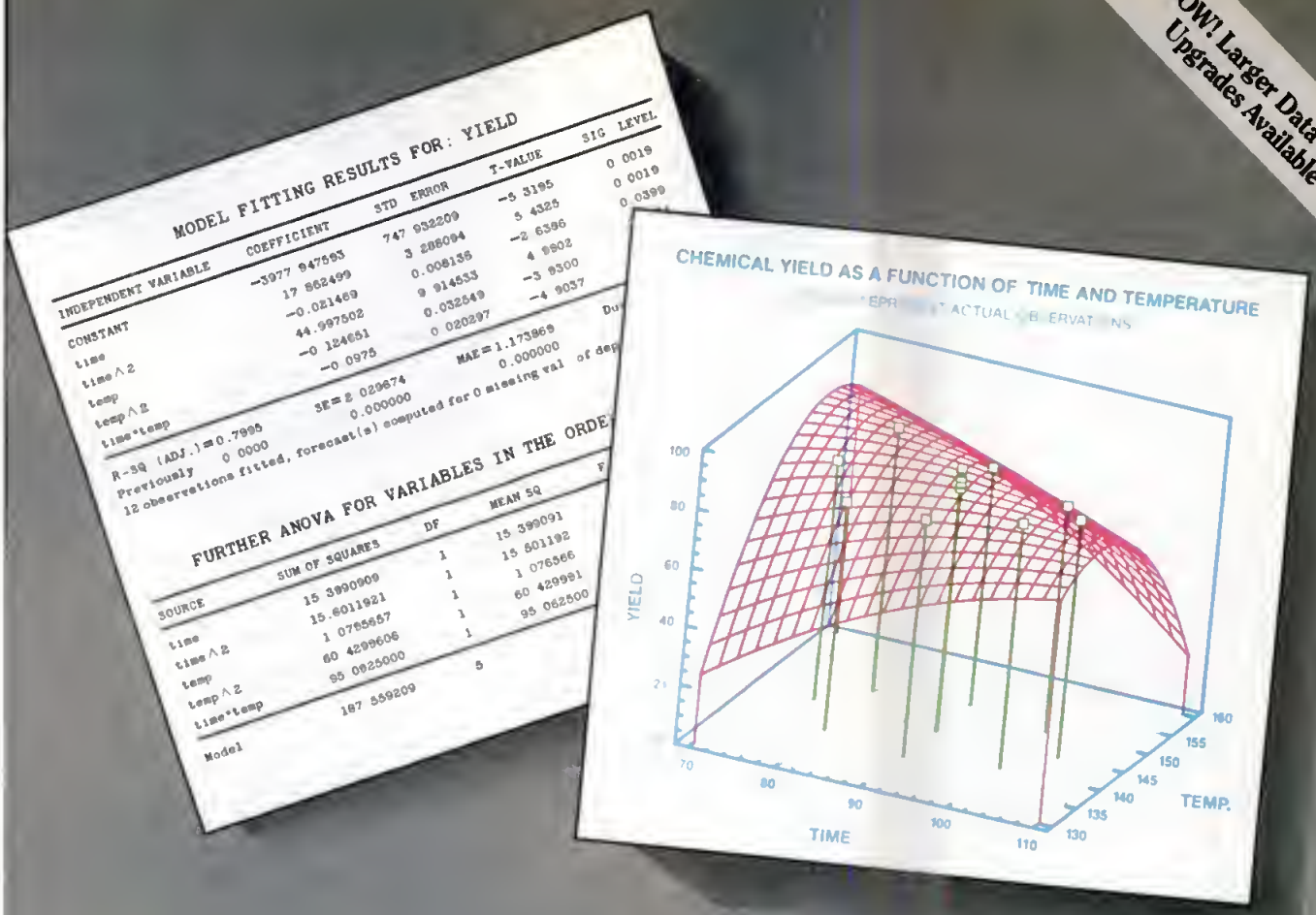

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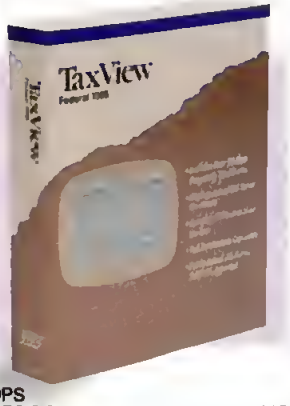

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DB Fast Compiler ..... 62.
Herverd Associates
PC Logo 3.0 ..... CALL
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Peter Norton
Norton Assembly Lng. ..... 55.
True BASIC
True BASIC 2.03 w/Runtima ..... 57.

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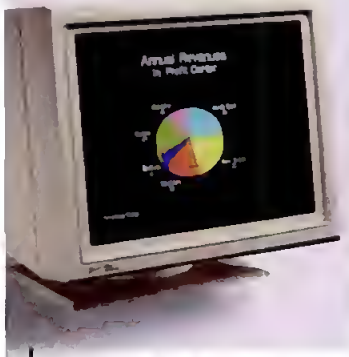

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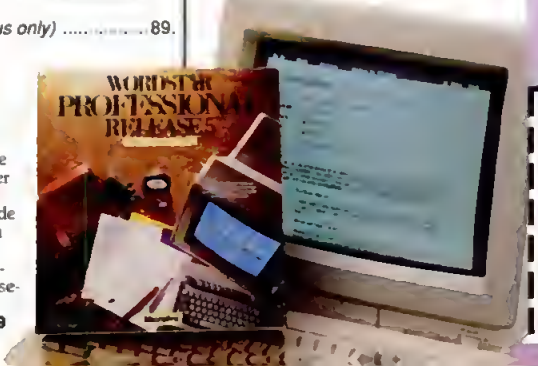

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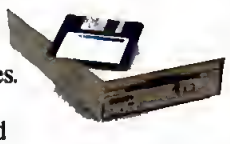

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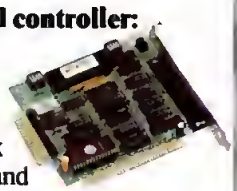

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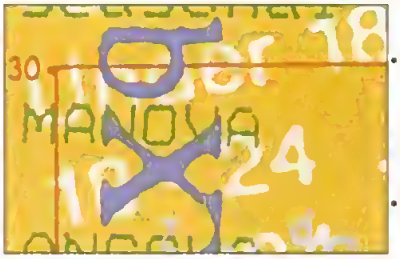


ADVANCED

Each of these packages houses a kitchen sink of statistical powers. While not all advanced stat packages are created equal, and while some perform with considerably more flexibility and finesse, this group shares certain high-level capabilities.

All of them have programming languages that make it possible to handcraft a complex statistical procedure. They tend to be faster and are able to handle larger data sets than their basic counterparts. All add high-level operations to their repertoires. Multivariate analysis, time-series analysis, factor analysis, nonlinear regressions—operations of this type separate the stat-package men from the boys. Advanced packages are more than a simple checklist of textbook procedures: they have sophisticated data-editing and handling capabilities and include diagnostic routines that test your underlying assumptions.

Two distinct camps of advanced stat packages are emerging. Those descended from the mainframe environment are hawking portability; those born on the PC are still feeling their oats, but they're selling attractive menu-driven interfaces and compelling graphics.

The BASS System

The BASS System, $399 from the the BASS Institute, is a package that will appeal to users of mainframe *SAS* who would like a *SAS*-like program for their PCs. While *BASS* has its own command language, most *SAS* commands are aliases for *BASS* commands. Thus, a user can enter the *BASS* command Run average or the *SAS* command Proc means with the same result.

BASS contains an extensive data language and impressive transformation capabilities, including for-next loops and if-then-else constructions. Experienced *SAS* programmers will note the presence of the Retain statement, which allows programming across observations. *BASS* language statements can appear in most procedures. For example, assignment statements can be used to create temporary variables for use within a specific procedure.

BASS makes direct use of character data and does not require that it be recoded to numerical values. Nearly every procedure can produce output data files that can be subjected to further analysis by *BASS*.

BASS allows the designation of dynamic variables whose values are functions of other variables. Only the definitions are stored; the values are recreated at runtime. This can lead to huge savings in space when dealing with large data sets.

The manual is concise and well written. Experienced *SAS* users will be tempted to make the mistake of skimming the documentation—a mistake because the manual can teach you almost as much about *SAS* as it can about *BASS*.

The BASS Institute maintains a BBS for users to report bugs, seek technical assistance, and upload problem data sets. Answers to queries are posted on the board within 24 hours of receipt, and the BASS Institute quickly makes fixes available for reported errors.

Potential users should be aware that *BASS* procedures are not full implementations of their *SAS* counterparts. For example, the Plot procedure cannot produce coded scatterplots. Coded scatterplots are displays in which a variable such as *gender* (containing the values M and F) is used to specify the plotting symbol for each case.

Furthermore, none of the linear models' procedures produce regression diagnostics to help evaluate the appropriateness of the fitted model. Residuals must be constructed manually by using predicted values saved in a *BASS* data set during the model-fitting procedure.

The ANOVA procedure doesn't allow multiple comparisons. There is no equivalent of the *SAS* Proc GLM's Means statement. Multivariate and repeated measures analysis of variance are not yet implemented, nor can the user specify the error term to be used for evaluating particular effects. And the ANOVA procedure does not analyze nested designs properly.

Other limitations have to do with the way certain procedures are implemented. *BASS* automatically sets illegal values (letters in numeric fields, for example) to "missing" without flagging them. This speeds up *BASS* processing time but places an extra burden on whoever creates the raw data file.

Implied variable lists are not allowed, and there is no way to display more than one box-and-whisker plot on a single page for easy visual comparison of subgroups.

Another problem with the package is its Count procedure: it's terribly slow. A task requiring the generation of 23 frequency tables from a data file of 1,550 people took more than 20 minutes on 10-MHz AT both with and without a math coprocessor. The same task took *Systat* 5 minutes without a coprocessor and 2½ minutes with a coprocessor.

The Plot procedure can display only one digit to the right of the decimal point

PC MAGAZINE FACT FILE

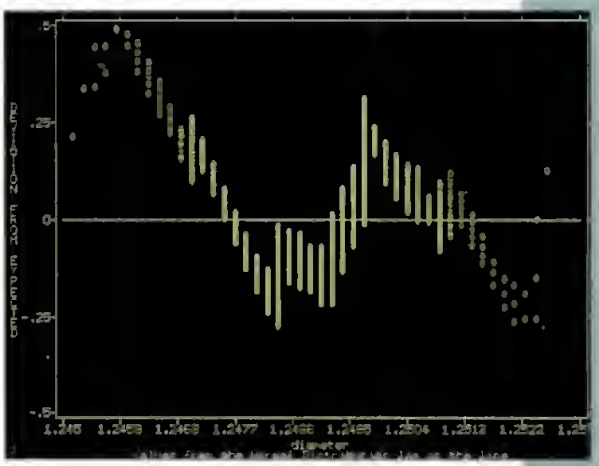
***The BASS System*, Version 88.10**
BASS Institute Inc.
P.O. Box 349
Chapel Hill, NC
27514
(919) 489-0729
List Price: $399, with 90-day money-back guarantee
Requires: 384K RAM, DOS 2.0 or later. Hard disk recommended.
In Short: *BASS* runs many *SAS* command files with minor changes, if any. However, the program's statistical routines are not complete implementations of their *SAS* counterparts. Not copy protected.

CIRCLE **675** ON READER SERVICE CARD

when labeling the vertical axis of a scatterplot. In one example, involving observations that ranged from 0.12548 to 0.12553, the only value appearing on the vertical axis was 0.1, rendering the display utterly unreadable. Similarly, the Chart procedure bases its histograms on the integer portion of the data. The same data set as above resulted in a histogram with just one bar.

These limitations aside, what *The BASS System* does, it does well, and the package is worth a look for those whose analytic needs can be met by its capabilities. *BASS* comes with a 90-day money-back guarantee to encourage potential users to evaluate the package on their own computer running their own applications. The BASS Institute reports that an update scheduled for the first half of 1989 will address most of the concerns—the speed of the Count procedure in particular—mentioned here.

—Gerard E. Dallal



A normal distribution curve produced by *BMDP/PC* to test whether the data follows a normal distribution. If the data graphed here were normally distributed, all points would lie on the 0 line.

BMDP/PC

For over 20 years, *BMDP*, from BMDP Statistical Software, has been generally regarded as one of the premier mainframe statistical packages. Yet while the program has been respected and praised for its excellent and complete statistical abilities, it has been no deep secret that the package is also hard to use. Many people use *BMDP* on their mainframes in much the same way as I did: to check and expand upon the results from other packages.

When *BMDP* was first ported to PCs several years ago, it still suffered from the same weaknesses. However, Version 1988 ($395) shows a number of improvements, including an extensive and excellent data-management capability, a full-screen editor, extensive on-line help, high-resolution graphics with multiple font choices, plus some new statistical procedures, including correspondence analysis.

While these changes have not solved all of *BMDP/PC*'s ease-of-use problems, they have certainly alleviated them. As a result, *BMDP/PC*, Version 88.10, is more interactive than ever. Still, there is plenty of room for improvement. Whereas a fully interactive package would execute a single command line as the user entered it and then return control of the program back to the user, one must still write multiline commands in *BMDP/PC*.

At least two of what *BMDP/PC* terms *paragraphs* are necessary to run each statistical program: an *input* paragraph telling the program what data to use, and a *statistical procedure* paragraph telling the program what to do with the data. The procedure paragraph must come before the input paragraph, so if you decide while entering your input paragraph that you want to use a different procedure, you must return to the main menu, choose the other procedure, and then reenter the editor. Similarly, if you want to use two different procedures on the same data, you must step back to the main menu (or to DOS) between procedures.

BMDP/PC produces superb statistical results, as well as high-resolution graphs. The macro facility, including a limited looping ability, increases the ease of use in the batch environment. However, if a statistical procedure is not available, the user cannot add it to the PC version of the package. But if you have *BMDP/PC* on a larger machine, a simple procedure is available for importing and exporting special files that retain the information describing the data—such as names, labels, and missing-value flags—as well as the data itself.

BMDP/PC easily handled the traditional statistical portions of the five tasks, including reading the raw ASCII files and transforming variables, but had trouble with some of the specialized applications that asked for procedures not built into the package. The worst in this regard was the quality control engineering task, since *BMDP/PC* does not offer either x-bar or Pareto charts. Similarly, in the social sci-

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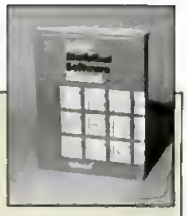

***BMDP/PC*, Version 1988**
BMDP Statistical Software
1440 Sepulveda Blvd., #316
Los Angeles, CA 90025
(213) 479-7799

List Price: Introductory package: $395 for 6 programs; standard package: $695 for 12 programs; $1,695 for 29 programs (both packages include *Data Manager* and *Plot Enhancer* utilities); full package: $1,995 for 41 programs. Separate programs available for $60 each, utilities for $95 each.

Requires: 640K RAM, hard disk, math coprocessor, DOS 2.1 or later. CGA and printer or plotter required for *Plot Enhancer* utility.

In Short: *BMDP/PC* includes all the programs from the mainframe version of *BMDP*—and they all run the same way. *BMDP/PC* retains its extensive high-quality analytic capabilities. Unfortunately, ease of use remains *BMDP/PC*'s weak point. Not copy protected.

CIRCLE 673 ON READER SERVICE CARD

ence research task, traditional measures of reliability such as Cronbach's alpha are not present, though with some work on the part of the user, applicable results can be obtained.

BMDP/PC had no problem with the biological research task, the marketing research survey (though it has no stub-and-banner table ability), and the forecasting task. However, the program lacks the ability to format the resulting output from analyses; you must read the resulting ASCII file into an editor if you want to include the output in a report.

The documentation and technical support are both excellent (although the technical support people did know I was a reviewer). In particular, the documentation

Unlike most stat programs, CSS is entirely menu-driven.

not only explains each procedure, but also offers detailed examples of the output and presents the computational algorithms used.

The number of new statistical procedures included in *BMDP/PC* seems to increase with each release, as does the sophistication of older procedures. *BMDP/PC* includes numerous procedures, and each is among the best in existence. Many of these procedures are also unique to this package; you won't find them anywhere else. Such exclusive features include correspondence analysis, the ability to describe the pattern of missing data, and the ability to use several different methods to replace missing values with estimated values.

BMDP/PC is aimed at professional data analysts and statisticians. The company also sells *SOLO*, "the standalone solution for nonstatisticians," for $149. *SOLO*, a licensed version of *NCSS* (*Number Cruncher Statistical System*—also reviewed in this section) is clearly a side-product for BMDP Statistical Software. However, the company intends to be selective about which aspects of *NCSS* it will sell under the *SOLO* name.

—Richard Goldstein

CSS

CSS, $495 from StatSoft, is a relatively new statistical analysis package with impressive capabilities. The range and speed of Version 2.1's procedures are comparable with the best PC statistical packages.

Unlike most packages, *CSS* (Complete Statistical System) is entirely menu-driven; it is designed around a series of modules that are called from a central menu. Although the complete package requires almost 8MB of disk space, each module is loaded separately; hence *CSS* will run on a two-floppy-disk PC. Even on such a machine, however, the program's speed will be adequate for small data sets.

Menu systems are often easy to learn because they display your choices on the screen. *CSS* is more intensively menu-oriented than are most other menu-driven packages. For example, after a given procedure, many packages display one or more screens of statistical results. *CSS*, on the other hand, presents few results without menus. This sort of rigidity makes *CSS* easy to learn, but it slows down anyone who is not a beginner.

The package's data handling should be sufficient for most users. *CSS* can import and export ASCII, *Lotus 1-2-3*, and *dBASE* files. It can concatenate and merge files, select cases, and recode variables. A lightning-fast spreadsheet-style editor is available to examine *CSS* data files, and a programming language called CSS Pascal handles complex transformations, including user-defined functions. Up to 300 variables and 32,000 cases can be stored in a *CSS* file.

CSS also comes with FORTRAN, C, Pascal, and BASIC source code to read and write *CSS* data files. This is an excellent idea that will appeal to users with special statistical applications or unusual data management or graphics needs.

Help files offer general information about each module but do not give information concerning specific menu choices within a module, limiting their usefulness.

The accompanying manual includes a tutorial introduction to each module, and while very thorough on the simpler modules—displaying screen images of every menu—it is nonetheless deficient in terms of describing the more complex modules. For example, the general MANOVA module is probably the most complicated feature the package offers, yet the manual omits important descriptions of how to set it up for many designs and tests. Because of this deficiency, a good number of users will be unable to make full use of the package's capabilities.

Furthermore, the manual's index is much too scanty. Not only have entries for many complex statistical terms—terms that are often confusing and need to be defined—been omitted, but there are no definitions to be found for standard, commonplace terms such as *mean*, *median*, and *variance*. Still, on the whole, the manual is satisfactory.

CSS includes *Intergraph*, a custom version of New England Software's *Graph-in-the-Box*. You can use *Intergraph* to capture data from virtually any *CSS* screen, customize it with labels, titles, and annota-

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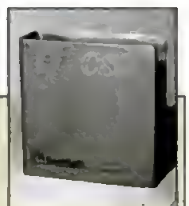


CSS, Version 2.1
StatSoft Inc.
2325 E. 13th St.
Tulsa, OK 74104
(918) 583-4149
List Price: $495
Requires: 512K RAM (640K recommended), DOS 2.1 or later. Hard disk recommended.
In Short: A large, integrated statistical package with graphics and database management capabilities. *CSS* is completely menu-driven and very fast. However, it's clumsy to use, and the statistical procedures are uneven in quality. Its strongest capability is MANOVA; its weak point is analysis of marketing and survey data. Not copy protected.

CIRCLE 672 ON READER SERVICE CARD

tions, and then print it as a high-resolution color-bar chart, pie chart, or scatterplot. Unfortunately, the range of graph types is limited.

Statistically, this package has many strengths. It is especially notable for the range of its procedures and the high speed with which they execute. And despite its accompanying documentation, the flexible MANOVA procedure is excellent.

Still, these strengths must be contrasted against a series of unusual design decisions. Variables, although given names, can be referred to only by number. This invites subtle errors, such as typing *v21* when you meant *v12*. In addition, the Tables procedure will not produce one-way tables; that is taken care of by the histogram function in the graphics module.

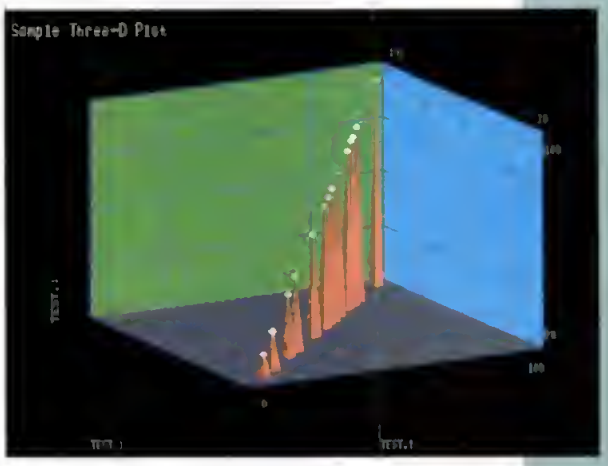
It is also important to note that most graphics, as well as ANOVA and MANOVA, require you to manually enter the values designating each category (*i.e.*, 1 2 3 . . .). This is something a computer should be able to figure out by itself. Also, while you can usually display a list of variable names and numbers by pressing a function key, inexplicably this doesn't work in graphics when you are designating which variable to plot.

CSS is weak when it comes to analysis of marketing and survey data. There is no way to label variables or values, and character variables are not supported. And the program doesn't include data-cleaning functions. The inability to weight cases means that stratified samples cannot be analyzed.

In general, this package should be characterized as broad and fast, but clumsy and uneven. Still, it is a new package that has been developed very quickly. Its shortcomings aside, *CSS* does have a lot of potential.—**Grant Blank**

NCSS

NCSS, $99 for the base system from Number Cruncher Statistical Systems, is very easy to learn and includes numerous statistical procedures, superb graphics, good documentation and technical support—but no flexibility.



NCSS is a graphics marvel. It handles rotated 3-D spike graphs, such as this one, and also can manage star graphs, point clouds with vapor trails, and Chernoff faces.

In Version 5.01, there is only one area in which the user can possibly do something that the vendor has not already thought of: data transformations. The user can use algebraic or if-then logic to accomplish virtually any form of simple data transformation, as well as many quite complex ones. The complexity is limited only by the space allowed for user input: one line per transformation.

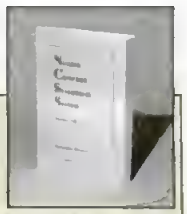
Even in the graphics module, otherwise superb, the user has little or no control over the output from within *NCSS* (*Number Cruncher Statistical System*). As with many other packages, the user has no control over the output from analyses, though one can write the output to an ASCII file and then use a text editor to edit or change the format.

NCSS offers numerous techniques, and the list grows every few months. Even better, the new techniques are usually added as separate modules, so you can choose to add on to the system when appropriate. As with *BMDP/PC*, this means that the user can purchase only the types of analyses desired, though *BMDP/PC* goes one better, by selling individual techniques. And you don't have to clutter up your shelves with enormous manuals, since each module has its own manual (*BMDP/PC* just sells two enormous manuals that cover every statistical procedure).

The user interface is a series of boxes that *NCSS* refers to as "panels." You basically answer the questions in the boxes and then hit a key to run the panel. Hitting the Alt-C combination will fill many panel boxes with default values, easing the process. A different panel is used for each procedure or creation of a graphic. What's nice about the panels is that they can be saved and reused. The worst thing about the panel method is you can't do anything that's not on the panel, which lends no flexiblity to the system.

The panels can be very irritating and slow to fill out: you must keep looking at

FACT FILE



***NCSS*, Version 5.01**
NCSS Inc.
865 E. 400 North
Kaysville, UT 84037
(801) 546-0445
List Price: $99, Dynamic Graphics module, $59; Power Pack module, $49; Experimental Design and Quality Control module, $49; Survival Analysis module, $59. *NCSS* version that supports math coprocessor, additional $5.
Requires: 512K RAM, DOS 2.0 or later.
In Short: *NCSS* offers a wide variety of analytic techniques and excellent two- and three-dimensional graphs, as well as dynamic (rotating and brushing) graphics in a fill-in-the-panel type of package. Although this "panel" design makes the package very easy to learn, it is awkward, slow, and inflexible. Not copy protected.

CIRCLE **671** ON READER SERVICE CARD

the screen to ensure that a typo has not put you in the wrong box on the panel. And you cannot select the defaults with one key, but instead must recall the name given to the panel and then load that panel. *NCSS* supplies only minimal on-line help: a list of function-key definitions and a few lines of help for each panel box.

Since it doesn't include ARIMA, *NCSS* was unable to do the forecasting task; however, the company says this will be added to the program this winter. *NCSS* cannot generate a Pareto chart, but otherwise the program had little trouble with the quality control engineering task. Another problem the program had with this task points to an issue that is important for all *NCSS* modules: the x-bar chart is squished together on the left side of the screen. This undesirable occurrence is the result of the program's inflexible design. Our x-bar chart includes only eight sample times and, as stated by *NCSS* technical support, the texts strongly recommend at least 40 to 50 time points because that is what the program leaves room for. This reliance on usually unnamed constraints runs throughout the program and can cause problems for those who disagree with the decisions made.

The program had trouble with the marketing research survey and social science research tasks largely because *NCSS* will accept only numeric data and will turn everything else into a missing value. Another stumbling block for the program in the social science research task is the absence of certain specialized techniques, such as reliability analysis and stub-and-banner tables.

Graphics is the strongest point of this program. Not only does one get standard two- and three-dimensional graphics, but one can rotate three-dimensional point clouds, with or without vapor trails, and one can "brush" (selectively highlight) points in either two- or three-dimensional scatterplots. Unfortunately, the only hard copy driver supplied with the program is for an HP plotter, and *NCSS* offers no font choices for its graphics.

Technical support is very good, when it is available. However, since *NCSS* is basically a one-person company, technical support is not always available when you need it. The manual is very clear and very good at what it does: it serves as a tutorial for the program. The panels are fully described, and examples of the output are given. However, the manual includes very few technical references and little discussion of computing algorithms.

—Richard Goldstein

Prodas

Prodas (*Professional Database Analysis System*), from Conceptual Software, is a database ($720), graphics ($365), and statistical analysis ($420) package, notable for its extremely fast, flexible database operations and its powerful programming language, similar in many ways to the *SAS* system. *Prodas*'s programming language is similar to that of *SAS*; its procedures are implemented the same way and named the same as in *SAS*.

Prodas modules are transparent: the appropriate module is automatically loaded into memory when a user invokes a statistical, graphics, or database procedure. With some disk-swapping, *Prodas* will run on a two-disk-drive PC. Even in that environment, it will be very fast.

The program can run interactively, but the lack of on-line help combined with the tersely written manual means that only experienced users will be able to do this productively. It is more commonly used as a batch language; here the data-management language shines. *Prodas* can merge or concatenate several files, and it can handle character variables containing up to 200 characters.

Prodas has over 100 functions to manipulate character and numeric data, probability, trigonometry, date, time, and financial problems. Other features include nested begin-end blocks, while and until loops, and subroutines. This is one of the most complete data-management languages available.

Prodas is notable for its ability to create and maintain indexed databases with multiple index variables. A supporting set of database operators allows users to search for, read, write, and edit individual records. These features will appeal to users with large databases that are time-consuming to read sequentially and to those with databases that often change or need to be updated regularly.

A menu-design module facilitates the development of a front end to *Prodas*. This could be used by clerical staff to build and maintain a database, thereby freeing time for more technically skilled personnel to pursue other activities.

Prodas loses points for its limited range of statistical procedures. It cannot do such common procedures as reliability, time-series, or log-linear models. And the statistical procedures that are available are often very limited. For example, the general linear-model procedure will not handle multivariate models and is unable to save any diagnostic information at all, including simple residuals. The regression procedure is a little more sophisticated. It will save various diagnostics: residuals, predicted values, Cook's D, studentized residuals, and others.

Prodas is more complete in its handling of categorical data. It can do multiway tables with measures of association, stub-and-banner tables, and handles multiple-response data. Unfortunately, although variables can be labeled, there is no way to label values.

Prodas's present graphics capabilities are completely unsatisfactory. It can do scatterplots, line plots, bar charts, and pie

FACT FILE

Prodas
Conceptual Software Inc.
P.O. Box 56627
Houston, TX 77256-6627
(713) 667-4222
(800) STAT-WOW
List Price: database, $720; statistical analysis, $420; graphics, $365.
Requires: 320K RAM, DOS 2.0 or later. Hard disk recommended.
In Short: A large, integrated database package with statistics and graphics capabilities, *Prodas* is very similar to the *SAS* system, but is very fast. However, its statistical procedures and graphics capabilities are limited. If you know *SAS* and your primary need is a fast database with more statistics than you'd find in standard packages, then *Prodas* deserves careful consideration. Not copy protected.

CIRCLE 670 ON READER SERVICE CARD

Advanced Statistical Analysis: Summary of Features

(Products listed in ascending price order)

Certain features are common to all industrial-strength statistical packages. All the products reviewed in this section import and export ASCII files and support a math coprocessor. They can sort data, perform data transformations, and supply basic descriptive statistics—means, medians, standard deviations, and frequency counts.

These packages can perform chi-square tests, univariate t-tests, and matched pairs. They do Pearson's correlations and Spearman rank order analyses; ANOVA and regression (both linear and standard multiple) are also included in all these programs. Finally, they can all display data results in basic bar and line graphs, histograms, and scatterplots.

The features in this accompanying table will give you a basis of comparison on the points in which these packages differ.

GENERAL PROGRAM FACILITIES	NCSS $99.00	The BASS System $399.00	Turbo Spring-Stat $469.95	CSS $495.00	Sigstat $595.00	Stata $595.00
Data import and export						
Imports/exports .DIF files	○/○	●●	●●	●●	○/○	○/○
Imports/exports Lotus 1-2-3 files	○/○	○/○	○/○	●●	○/○	○/○
Imports/exports .DBF files	○/○	○/○	○/○	●●	○/○	○/○
Expert language	○	●	●	○	○	○
Macro facility	○	○	○	○	○	●
Batch facility	○	●	○	●	●	●
Expanded/extended memory support	○	○	○	○	○	●
EGA support	●	○	●	●	●	●
Maximum number of observations	32,000	32,767	10,000	32,000	Unlimited	20,968
Maximum number of data points per file	60	4,096	500	300	Unlimited	39
Maximum number of variables	250	4,096	500	300	Unlimited	254
Weighting allowed	●	●	●	○	●	●
DATA MANIPULATION						
Data verification	○	○	●	○	●	●
Spreadsheet-type editor	●	○	●	●	○	○
Error trapping	●	●	●	○	●	●
Table look-ups	○	○	○	○	○	○
Conditional case selection	●	●	●	●	●	●
Rank order	●	●	●	●	○	●
STATISTICAL ANALYSIS						
Descriptive statistics						
Modes	○	●	●	○	○	○
Sums	●	●	●	○	●	●
Percentiles	●	●	●	○	●	●
Multiway table	○	●	●	●	●	●
Cross-tabulations	●	●	●	●	●	○
Correlations						
Partial	●	○	●	●	●	●
Canonical	●	○	●	●	●	○
Reliability testing	○	○	○	●	●	○
Analysis of variance						
ANCOVA (analysis of covariance)	●	●	●	●	●	●
Latin-square	●	●	●	●	●	○
Nested design	●	●	●	●	●	●
Principal-component analysis	●	○	●	●	●	○
Contrast and planned comparison	●	○	●	●	●	●
Post hoc tests	●	○	●	●	●	●
Split plot design	●	○	●	●	●	●
Unbalanced design	●	●	●	●	●	●
Multivariate analysis						
MANOVA (multivariate analysis of variance)	●	○	●	●	●	○
MANCOVA (multivariate analysis of covariance)	○	○	●	●	●	○
Discriminant analysis	●	○	●	●	●	○
Factor analysis	●	○	●	●	●	○
Hotelling's T squared	●	○	○	○	●	○
Multivariate confidence intervals	○	○	○	●	●	○
Repeated measures	●	○	●	●	●	●

—Editor's Choice ●—Yes ○—No

StatPac Gold $595.00	BMDP/PC $695 00 (standard package)	P-Stat $695 00	SAS $745 00 (includes $250 fee)	SPSS/PC + $795 00	Systat with Sygraph $795 00	Statgraphics $895.00	Prodas $1,140 00 (database and statistical modules)	RS/1 $2,000.00
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○/○	○/○	○/○	○/○	●●	●●	●●	●●	○○
○	○	●	●	○	●	○	○	○
○	●	●	●	○	●	○	●	●
●	●	●	●	●	●	○	●	●
○	○	○	●	●	○	●	○	●
●	●	○	●	●	●	●	●	●
32,767	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
500	Unlimited	300	Unlimited	500	256	Unlimited	Unlimited	Unlimited
500	Unlimited	300	Unlimited	500	256	Unlimited	Unlimited	Unlimited
●	●	●	●	●	●	●	●	○
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○	●	●	●	●	●	●	●	○
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Advanced Statistical Analysis: Summary of Features

(Products listed in ascending price order)

	NCSS $99.00	The BASS System $399.00	Turbo Spring-Stat $469.95	CSS $495.00	Sigstat $595.00	State $595.00
STATISTICAL ANALYSIS						
Log-linear models	○	○	○	●	●	○
Regression						
Nonlinear	●	○	●	●	●	○
Logistic	●	○	●	●	●	●
Probit	●	○	●	●	●	●
Stepwise	●	●	●	●	●	●
Cluster analysis	●	○	●	●	●	○
Multidimensional scaling	○	○	●	●	●	○
Nonparametric measures						
Fisher's exact test	●	●	○	○	●	○
Mann-Whitney U	●	●	●	●	●	●
Kendall's tau	●	●	●	●	●	○
Kolmogorov-Smirnov	○	○	●	●	●	●
Wilcoxon	●	●	●	●	●	●
Time-series analysis						
Transforms (such as fast Fourier)	○	○	●	●	●	○
Data smoothing, filtering, tapering	●	●	●	●	●	●
Auto-correlation analysis	●	○	●	●	●	○
ARMA, ARIMA modeling	○	○	○	●	●	○
Automatic model selection	○	○	●	○	●	○
Cross-correlation analysis	○	○	●	○	●	○
Spectral analysis	○	○	○	●	●	○
Survival analysis	●	○	○	○	●	●
DATA REPORTING						
Default report styles	●	○	●	○	●	●
Customized report styles	○	●	●	○	○	●
GRAPHICS						
Box and whisker plots	●	●	●	●	●	●
Pie charts	○	●	○	●	●	●
Probability plots	●	●	●	○	●	●
Error bars	●	○	●	●	○	●
Control charts	●	○	○	●	●	●
Log and semi-log charts	○	○	○	○	●	●
Pareto charts	○	○	○	●	●	●
Two-dimensional						
Stem and leaf plots	●	●	●	○	●	○
Casement plots	●	○	○	○	○	●
Overlay plots	●	●	○	●	○	●
Three-dimensional x-y-z plots	●	○	●	○	●	○
Multidimensional Chernoff faces	●	○	○	○	○	○
Graphs can be edited	●	○	○	●	●	●
Multiple fonts supported	○	○	○	○	●	○
OUTPUT						
Laser printers	○	○	●	●	●	●
Plotters	●	○	○	●	●	●
Film recorders	○	○	○	○	○	○
Color printers	○	○	○	●	●	○
HELP AND DOCUMENTATION						
On-line help	●	●	●	●	○	●
Tutorial	●	●	●	●	●	●
Toll-free telephone support	○	○	○	○	○	●

—Editor's Choice ●—Yes ○—No

StatPac Gold $595.00	BMDP/PC $695.00 (standard package)	P-Stat $695.00	SAS $745.00 (includes $250 fee)	SPSS/PC+ $795.00	Systat with Sygraph $795.00	Statgraphics $895.00	Prodas $1,140.00 (database and statistical modules)	RS/1 $2,000.00
○	●	●	●	●	●	●	○	●
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○	●	○	●	●	●	●	○	○
●	●	●	●	●	●	●	○	●
●	●	●	●	●	●	●	○	●
●	○	○	○	○	○	○	○	●

charts, and each graphic has a wide range of display options. However, many important graphic types are completely missing: probability plots, box plots, and stem-and-leaf plots. An upgrade now in beta testing promises to remedy this problem.

The documentation is uniformly poor. There is no tutorial manual, and the reference manual is so uninformative that it's difficult for even an experienced person to use. The general linear-models procedure, for example, is documented in only four pages with a single example. The User Guide has more examples, but on the whole, it is skimpy. Basically, users are forced to have the equivalent *SAS* manuals available in order to use *Prodas*.

Prodas is strong in database capabilities and boasts an excellent data-manipulation language. However, this usefulness must be balanced against the program's limited statistical capabilities, inadequate graphics, and poor documentation. If you know *SAS* and your primary need is for a fast database package with more-sophisticated statistical capabilities than standard databases like *dBASE* or *Paradox* offer, then (and perhaps only then) does *Prodas* deserve careful consideration.

—Grant Blank

P-Stat

P-Stat, $695 from P-Stat, is a statistical product that doesn't mess around. This is heavy-duty number-crunching software. The vendor describes it as "statistical analysis, data-management, report-writing, and data-presentation software for PCs, minis, and mainframes."

Because of this ability to run on a variety of machines (there are Unix versions, as well as ones for Sperry, Honeywell, and DEC's VAX computers—and even the IBM PC/RT) it makes sense that businesses would be attracted to *P-Stat;* the program has genuine upward mobility. Pay $695 for the DOS version now, and when you're ready to move on to a larger platform, *P-Stat* will have a version for you that works like it did on your PC.

I found *P-Stat*'s Menus add-on to be a necessary utility because *P-Stat* is very difficult to learn. Menus is actually a command-generator utility: by selecting the appropriate choices on the menus, you can build a complex command/subcommand/phrase set to perform the desired operation. Without Menus, I committed one syntax *faux pas* after another. After many hours that I spent generating commands with Menus and checking and altering them with the command editor, I was able to improve.

Because of the wide variety of platforms that *P-Stat* supports, the program makes little use of each machine's special features. Hence, the DOS version completely ignores the PC's graphics capabilities. All commands and reports are text-based and not particularly pretty to look at. In fact, documentation for all *P-Stat* versions is the same: two thick three-ring binders brimming with information. Only a small *P-Stat* Installation Instructions manual has any specific guidelines for the DOS environment.

The documentation, however, is excellent. It is written in a rather dry style (similar to the IBM mainframe manuals), but every piece of information you need is available in a well-indexed, cross-referenced form. P-Stat even includes a small tutorial to get you going and a very helpful Concise Reference (250 pages).

Going through the five script tasks (once I had overcome the steep learning curve) was a pleasure. *P-Stat* had the necessary power. The formulas necessary for doing the complex data transformation for the biological science test were available. The cross-tabulation functions produced nice results for the market survey. After a few false starts, the complex data-importation and data-cleaning functions required by the social science analysis were performed extremely well. Its performance on the quality control engineering test, however, was slightly disappointing. Although *P-Stat* features many other quality control tests not requested by the test data, there is no specific Pareto chart. However, I was able to generate one easily enough with the histogram-generation command.

The forecasting task showed off a nice *P-Stat* feature. The data for the analysis has 9 columns, but the last 2 columns are below, not beside, the other 7 (probably because they were generated on a system that could handle only 80 columns at a time). Using the *P-Stat* Join command, I was able to paste the two pieces of the file side by side to create a new, complete file. Yet there was one disappointment: although the documentation indicates that *P-Stat* performs ARIMA analysis, the software told me that ARIMA was not available in this release. P-Stat plans to include ARIMA in the next release.

P-Stat's data-manipulation functions reminded me of *dBASE II*. The software is able to massage and manipulate huge chunks of information, but in the terse, cryptic command style of the older database programs. It includes a programming language that is rich in features. Such capabilities as for-next loops and if-then conditional branching are not found in less-powerful statistics packages.

On the downside, *P-Stat* lacks some of the civilized touches of some other packages. It doesn't have a spreadsheet-like data editor. *P-Stat* also seems a little slow, and I found the command syntax to be cumbersome. But I realized that, as I got to know the commands by heart, the brief structure could enable me to become an efficient user.

If you're a weekend statistician for the local softball league, you can probably get by with a less-powerful and easier-to-use package than *P-Stat*. But if you need raw power, upward mobility, and excellent documentation, take a good look at *P-Stat*.

—Martin L. Ramsay

FACT FILE

***P-Stat*, Version 2.10**
P-Stat Inc.
P.O. Box AH
Princeton, NJ 08542
(609) 924-9100
List Price: $695 (including Menus utility add-on). Extended memory DOS version available.
Requires: 640K RAM, hard disk, math co-processor, DOS 2.1 or later.
In Short: A full-featured statistical analysis package with data manager, programming language, and report writer that runs on mini and mainframe platforms as well as on PCs. Not copy protected.
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RS/1

RS/1, $2,000 from Bolt, Beranek & Neuman (BBN) Software Products Corp., has been available on minicomputers (such as VAX) and mainframes for a number of years. Version 12.1 for the IBM PC is almost identical in syntax and function.

RS/1 offers a number of statistical and graphical tools that are accessed via a number of English-syntax-based commands. For example, a table, graph, or bar graph is created by entering Make graph or Make table. The user is then prompted for the name of the graph, its title, and data values, so it's simply a matter of filling in the blanks.

Simple statistical analysis is easily accomplished using the program's powerful command language. The power of such a presentation is immediately apparent for the statistics tyro. It's very pleasant to be taken by the hand through a complex statistic such as multiple linear regression. And the program's constant prompting forces you to think about the details of the problem you're trying to solve.

A strong feature of *RS/1* is the ease in which data transformations can be made. The Watch command shows the ongoing transformations of the data in the upper part of the screen, while allowing your commands to scroll by in the lower portion of the screen. This is a useful feature, allowing you to watch the data transformation as it occurs.

The true power of *RS/1* lies in its ability to string simple procedures together with RPL, its macro programming language, and to create analysis procedures not included in *RS/1*. RPL has a C-like syntax without any of the bother of "typing" of variables.

However, *RS/1* also has its limitations. It cannot automatically search for incorrectly keyed data, as was necessary for the data-cleaning portion of the social science research task. I did program such a test using the RPL macro language; however, the resulting macro took more than 15 minutes to execute.

The present version of *RS/1* does not contain a large range of statistical analyses. Multivariate linear regression, multivariate analysis of variance, and probit and logit analyses are just a few sorely missed routines. The manual suggests using *RS/1*'s interface routines to other packages, such as the PC versions of *SAS* and *BMDP*, and BBN's *Discover/Explore* mainframe program, to complete the analysis. BBN plans to include the missing routines in Version 4, which the company plans to ship in the first quarter of 1989.

The package's hard-copy output is definitely not publication quality since only a handful of dot matrix printers and plotters are supported. And you are given only minimal control over graphical modifications: I needed to completely redo the graphic and tabular results using other packages.

Worst of all, *RS/1* is known to have a number of bugs in the actual statistical algorithms. BBN is aware of these bugs and says they will be fixed in Version 4.

The documentation is excellent, with full explanations of each analysis. However, additional manual pages are not supplied to describe the bugs known to exist in the program.

The PC version of *RS/1* is a useful package if you have been using it for a while on a minicomputer or mainframe. It is also useful to those who know little about statistics and need to learn how to perform different analyses. I found it educational to watch different analyses step their way through to the completed answer. However, a beginner's dependence on the package requires BBN to ensure that they have addressed the bugs in their statistical analyses. If Version 4.0 delivers all that BBN plans, it will be worth a close look.

—Ralph M. Siegel

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***RS/1*, Version 12.1**
BBN Software Products Corp.
10 Fawcett St.
Cambridge, MA 02138
(617) 864-1780
(800) 251-1717
List Price: $2,000
Requires: 512K RAM, hard disk, DOS 2.0 or later
In Short: *RS/1* offers a number of statistical and graphical tools accessed via a powerful English-syntax-based command language. The present version of *RS/1* does not offer a large range of statistical analyses. Not copy protected.

CIRCLE 668 ON READER SERVICE CARD

SAS

Comprehensive is the term that best describes *SAS*, Version 6.03, the PC version of the mainframe *Statistical Analysis System* and for years the industry standard in statistical computing.

With the PC release, the SAS Institute has taken several steps toward making the software user friendly. On-line assistance, colored windows, and fill-in-the-blank procedure menus guide the user through the process of analysis. Having learned mainframe *SAS* many years ago (Version 2 under MVS and later Version 5 under CMS), I was pleasantly surprised by the ease and speed with which this powerful

PC MAGAZINE FACT FILE

***SAS*, Version 6.03**
SAS Institute
SAS Circle,
Box 8000
Cary, NC 27512-8000
(919) 467-8000
List Price: Base *SAS* for a single workstation: $495 with a yearly renewal fee of $250 for upgrades, documentation, and technical support. Additional option modules sell for $395 each with a $200 renewal fee. Quantity discount available for corporate customers.
Requires: 640K RAM, 20MB hard disk, DOS 2.0 or later, EMS supported and recommended; math coprocessor recommended.
In Short: *SAS* is a comprehensive statistical analysis package, offering both interactive and batch processing through either a menu system or an expert command language. Version 6.03 brings the powerful computing power of its mainframe standard to the PC, with some unfortunate deletions in functionality. The optional Micro-to-Host link facilitates PC processing of mainframe-based data, and the Assist option leads beginner users through the creation of *SAS* programs. Not copy protected.

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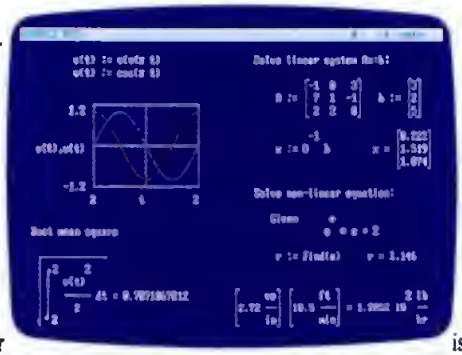

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MathCAD® MathSoft, Inc.

MathCAD®

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CIRCLE 154 DN READER SERVICE CARD

```
PARETO=. _ERROR_=1 _N_=20
NOTE: The infile 'c:\sas\pcdata\pareto.dat' is file C:\SAS\PCDATA\PARETO.DAT.
NOTE: 100 records were read from the infile C:\SAS\PCDATA\PARETO.DAT.
      The minimum record length was 1.
      The maximum record length was 1.
NOTE: The data set TASK.PARETO has 100 observations and 1 variables.
NOTE: The DATA statement used 13.00 seconds.
   10    data task.pareto;
   11      infile 'c:\sas\pcdata\pareto.dat';
   12      input pareto $ 1;
   13    run;
NOTE: The infile 'c:\sas\pcdata\pareto.dat' is file C:\SAS\PCDATA\PARETO.DAT.
NOTE: 100 records were read from the infile C:\SAS\PCDATA\PARETO.DAT.
      The minimum record length was 1.
      The maximum record length was 1.
NOTE: The data set TASK.PARETO has 100 observations and 1 variables.
NOTE: The DATA statement used 9.00 seconds.
   14    title 'Sample Pareto Analysis Chart';
   15    proc gchart;
   16      hbar pareto;
   17    run;
                                                    ZOOM
```

The comprehensive, command-driven *SAS* statistical software functions almost identically on the PC and on the mainframe.

program functions on an IBM PC.

For the user who's not accustomed to *SAS* procedures, an on-line tutorial with practice sessions sheds some light on the system. Defining data, storing *SAS* data sets in libraries, running basic procedures and writing batch files are all explained here. Information on converting *dBASE* or .DIF files to *SAS* data sets is contained in the useful Introductory Guide.

Despite all the help, though, the learning curve for *SAS* can be quite steep. The documentation for the basic system alone is over 400 pages long; advanced statistics are explained in another 1,000-page tome, and *SAS*'s picture-perfect graphics are detailed in yet another 500-page manual. The system we tested, which also included an Interactive Matrix Language, Micro-to-Host Link, Applications Facility, and a macro language, covered 22 volumes and came in 9 boxes of diskettes! Fortunately, the SAS Institute supplies a Master Index to help you locate the volume that explains the procedure you need to perform.

The *SAS* screen is divided into three sections: one for writing programs, one for the system's response as it executes the program, and a third for output tables and charts. *SAS* accepts both numeric and alphanumeric data and notes the location of any erroneous data read in from disk files. Syntax errors in programming are underlined in red on the system log screen, with notes explaining the type of statements the program would expect at that point in the given statistical procedure.

In operation, *SAS* read data from a variety of formats, recoded and transformed variables, produced frequency tables, cross-tabs, and basic charts and performed regression analysis without errors.

The only problem I encountered with *SAS* was its inability, due to insufficient memory, to draw a test graph on-screen. Of my computer's 640K of memory, less than 60K was available after reading in the graphics procedure. The technical support people at the SAS Institute recommend that those who will be using the *SAS* Graph procedure install LIM expanded memory on their systems.

SAS's custom cross-tabulation procedure, Proc Tabulate, has long been a favorite of mine. Although somewhat hard to master, it allows for user-formatting of complex nested cross-tabs, thereby saving many pages of output that would be produced using the regular cross-tab procedure. I have found Proc Tabulate to be much easier to use than the custom cross-tabulation Tables add-on found in *SPSS*.

A note to econometricians: while mainframe *SAS* systems include the *SAS* econometric time-series (ETS) analysis program, this add-on module was not yet available for the PC at the time of this review. The company said it should be available in the first quarter of 1989.

SAS computes a very wide range of descriptive and comparative statistics and performs ANOVA, MANOVA, factor and cluster analysis, plus least squares, GLM, and nonlinear regression, as well as many other procedures. An exhaustive set of options allows the user to customize the output and analyze statistical patterns in great depth. For the statistician who needs great depth and a wide range of statistical computing power, *SAS* is hard to beat.

—Frederick Barber

Sigstat

Sigstat, $595 from Significant Statistics, is one of the stranger products reviewed in this series. Instead of making any attempt to refine the product's user interface, its creators concentrated their efforts on providing a cornucopia of statistical computing functions. The result is a package for statistical "gearheads" who want power and don't mind wading through cryptic command files and arcane user prompts to get it.

Sigstat consists of a manual and 28 disks. The files are simply compiled FORTRAN programs and are completely unrelated to each other; there are no menus or other niceties linking them together. To use *Sigstat*, you pick the program you want to run and execute it at the DOS prompt. Most of the programs are line oriented: they ask you one question at a time and you respond. When you've answered

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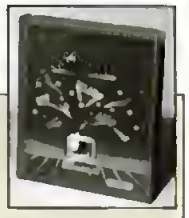
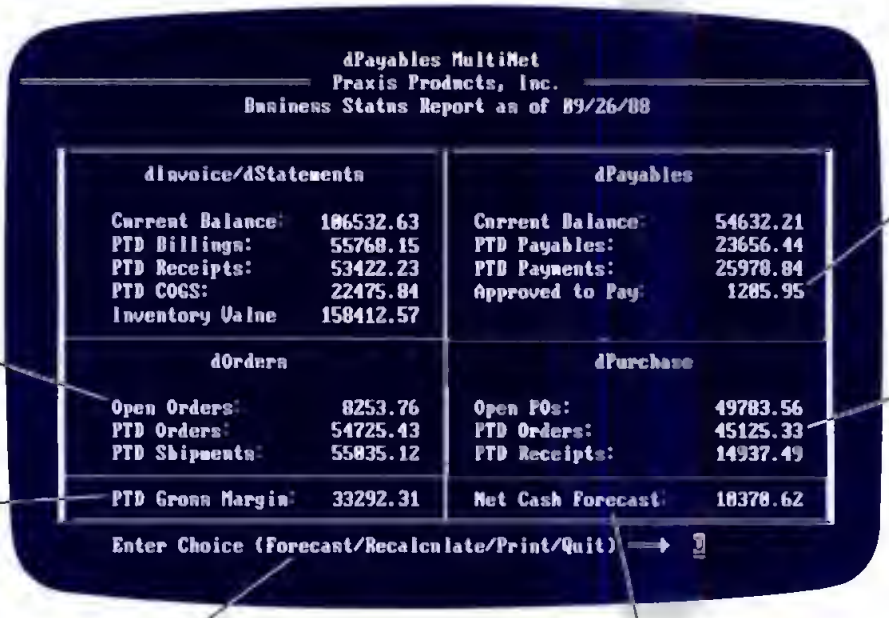


Sigstat
Significant Statistics
3336 N. Canyon Rd.
Provo, UT 84604
(801) 377-4860

List Price: $595; $395 for government, educational, and nonprofit organizations.
Requires: 512K RAM, DOS 2.0 or later. Certain routines require CGA, EGA, or Hercules compatibility.
In Short: An extensive library of statistical and graphing routines, intended to be used independently. *Sigstat* is only for the user who needs the statistics and doesn't want the creature comforts: the user interface is rather cumbersome. Not copy protected.

CIRCLE 666 ON READER SERVICE CARD

It's 11:05am. If you had our accounting software, you'd know where your business is.



11:05
"Great, back orders are down. Now let's push those sales."

11:06
"Gross Margins look good. We can pick up sales volume with some promotions."

11:07
Let's forecast where these numbers will be at the end of the month."

11:08
"Last week's cash forecast was $4,000. We're looking much better. We can put some into CD's."

11:09
"Cash receipts are up, I can approve a few more P.O.'s."

11:10
"Purchase Orders are close to sales this month. I'll call Mary and put the brakes on any more P.O.'s for a while."

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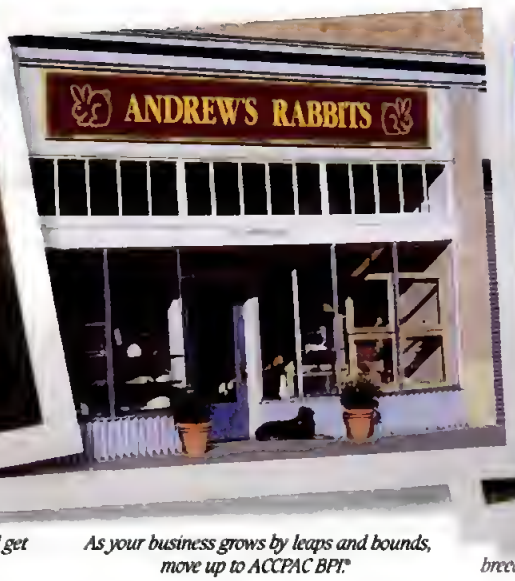

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reviews in *Software Digest.*

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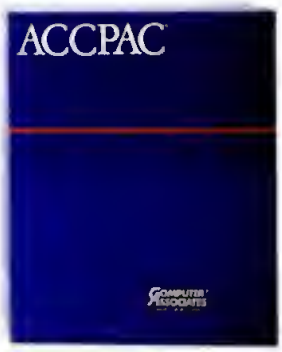

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MOVING DATA FROM ONE STAT PACKAGE TO ANOTHER

Need to use more than one statistical analysis package to complete your current project? DBMS/COPY, from Conceptual Software, makes it easy to move data files from one package to another.

No analyst enjoys having to work with more than one statistical analysis package on any project. Because no two packages store data in quite the same way, separate versions of data files must be maintained for each program. Once the inevitable modifications and corrections to the data files take place, the time spent reconciling differences between results from different programs can often be as great as the time spent carrying out the analyses themselves.

Most statistics programs are capable of importing and exporting ASCII files, but ASCII interchange is not a solution for transferring files. When moving documents in ASCII between word processors, you lose formatting instructions; ASCII interchange between statistical packages causes the loss of variable names, labels, and missing value designations.

One solution to the data transfer problem comes in the form of *DBMS/COPY*, $195, from Conceptual Software. *DBMS/COPY* translates data files among *ABstat*, *AutoBox Plus*, *BASS*, *BMDP*, *Gauss*, *GLIM*, *Minitab*, *NCSS*, *Prodas*, *SAS*, *SCA Statistical System*, *Soritec*, *SPSS/PC+*, *Stata*, *StatPac Gold*, and *Systat*. (Except for *GLIM*, all are reviewed in this issue: *Gauss* is reviewed in "Better Tools for Higher Math: When Numbers Count.")

In addition to statistical packages, *DBMS/COPY* knows the formats of the following databases, spreadsheets, and integrated packages: *DataEase*, *Datalex*, *dBASE III*, *Lotus 1-2-3*, *Oracle*, *PC-File*, *Paradox*, *Quattro*, *R:base*, *Reflex*, *Smartware*, and *Symphony*. The program can also translate pure ASCII files—both free-field and fixed-format—to the above file formats. Conceptual Software reports that, at present, it will support any package whose vendor supplies it with a copy of the program and a description of the file format.

DBMS/COPY makes adjustments for the way each system stores its data. It will translate integers into floating-point numbers when the target system does not support integer format, for example. Variable names are adjusted to avoid illegal names and duplications in the target file. *DBMS/COPY Plus*, at $295, adds variable creation, variable selection, and record selection to the data-translation features of *DBMS/COPY*.

With the exception of *Oracle* files, transformation from one format to another can be accomplished without having the package resident. A *Systat* user can pass along an *SPSS* file, for example, without having access to *SPSS/PC+*, while a *Stata* user can translate *SAS* files without having access to *SAS*.

Both the *DBMS/COPY* and the *DBMS/COPY Plus* packages come with a 30-day money-back guarantee.

—Gerard E. Dallal

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Conceptual Software Inc.
P.O. Box 56627
Houston, TX 77256
(713) 667-4222
(800) 782-8969 (orders/literature)

***DBMS/COPY*, Version 1.2**
List Price: $195 (plus $5 shipping and handling)
Requires: 256K RAM, DOS 2.1 or later.
Not copy protected.
CIRCLE 681 ON READER SERVICE CARD

***DBMS/COPY Plus*, Version 1.2**
List Price: $295 (plus $5 shipping and handling)
Requires: 256K RAM, DOS 2.1 or later.
Not copy protected.
CIRCLE 680 ON READER SERVICE CARD

all the questions, the program thinks a while and then gives you its answer.

Some of the programs cannot even be run in this "interactive" way: you must create a batch file in order to use them. Significant Statistics supplies a utility program for this purpose that generates a "command file or control card information (file) for any of the 25 batch-oriented programs." The user works through this command-file generator, answering the questions and specifying the name of the command file to generate, and the generator creates a file of control cards that are later used to run the batch program.

The process you must use to create control cards is similar to the one people had to use back in the days of card readers. In fact, like those old keypunched cards, the control cards generated by *Sigstat*'s utility program (which can be examined by using the DOS TYPE command or with a text processor) are divided into columns, and different data items are specified in rows of

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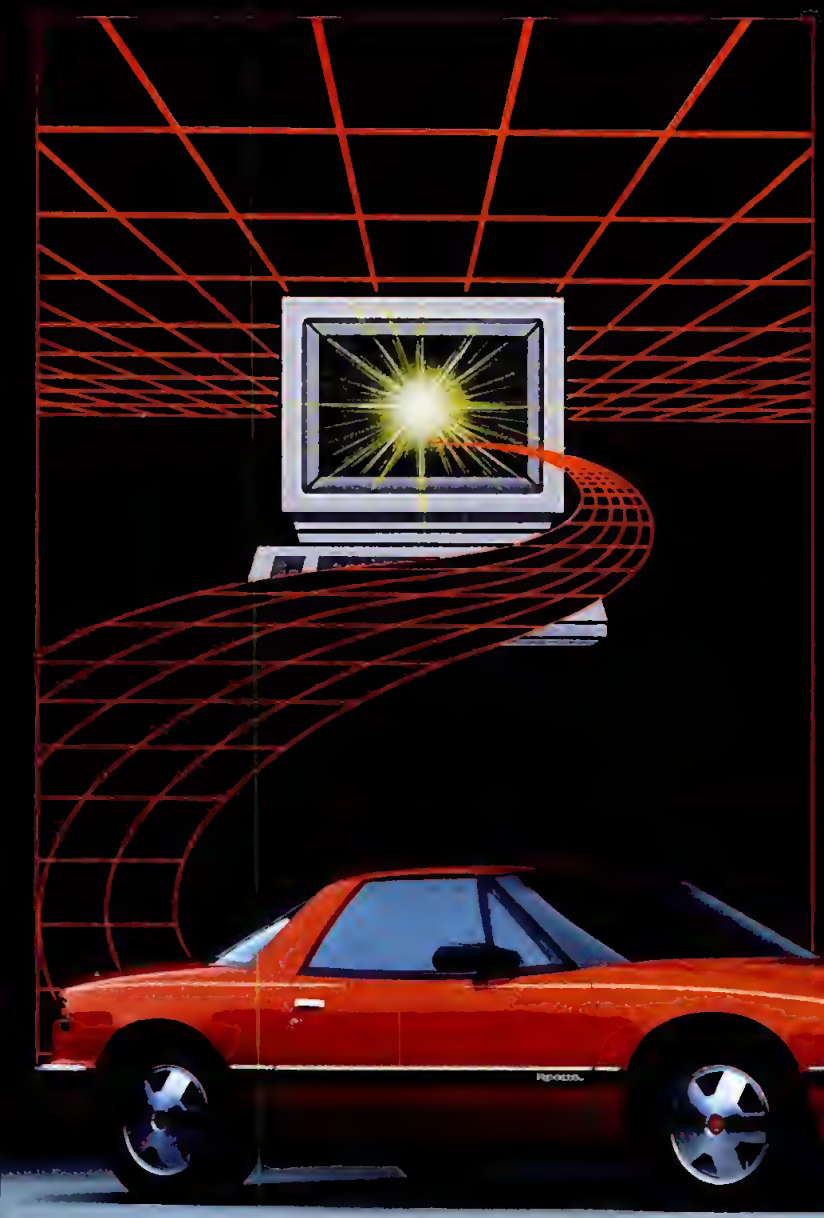

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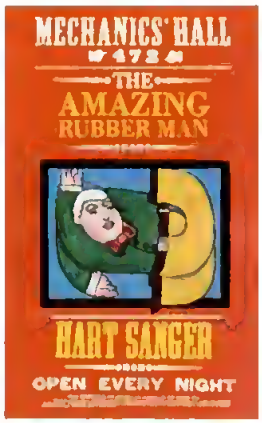

The Flexibility of Rubber Man

R2HOST isn't snobbish. It'll take a call from R2CALL from one of the Crosstalk Communications programs, from almost any other communications program, or from a communications terminal. R2CALL connected with R2HOST does give you all of the power and features of REMOTE^2, including exact keyboard mapping and the ability to transfer files with error-checking even while an applications program is running.

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columns. For example, in the batch program BMD05D (a program to create plots, histograms, and Pareto charts) columns 16 through 20 on the first card specify the number of cases in the data set. As with keypunched 80-column cards, if you discover errors after your batch file has been run, you must key in the corrections.

Sigstat requires you to use FORTRAN format statements to specify the location of the numbers you are interested in manipulating. Though they can be a pain to type in (for the biological research task, for example, the format statement is "3X,F3.0,7X,F3.0,17X,F3.0"), they can be an advantage in that you only need specify the fields you are interested in; the rest can be ignored. *Sigstat* routines will also let you insert the format statement as the first record in a data file so that you don't have to keep retyping it.

Sigstat's features fulfill any wish list, but the interface is hard to use.

The sad thing about all these inconveniences is that *Sigstat* includes almost every function listed on our features table, and the documentation has extensive footnotes and references to various scientific papers and journals. This package is like the answer to a statistician's wish list.

To *Sigstat*'s credit, the support staff at Significant Statistics was very helpful. They see their product as supplying the raw statistical number-crunching that people who analyze data require. They aren't interested in the whistles and bells, just the statistics. They do have several nice programs: for example, one called Explore allows you to move through your data looking for attributes and patterns. It includes the ability to create 3-D graphs and to view a graph from all angles.

It seems that though we've learned a lot about how to improve the interface between humans and computers since the days of the card reader, the folks at Significant Statistics have not been paying attention. Twenty-five years ago a product like *Sigstat* would have been hailed for its statistical power. Now it seems more like a rug beater: it gets the carpet clean, but these days most folks use a vacuum cleaner.—**Martin L. Ramsay**

SPSS/PC+

SPSS/PC+ from SPSS, $795 for the base system and $3,454 for the works, is a full-featured statistical analysis package. Version 3.0 is an adaptation of a well-seasoned program for mainframes and minicomputers. Its complex command structure is a legacy of this mainframe origin. What sets the PC version apart from its ancestors is an interactive system of menus and help screens, as well as its interactive execution.

The Fast Start on-line tutorial is like a 2-credit course in *SPSS*. It offers an excellent introduction to the package and its system of menus, function keys, and other special features, as well as an introduction to some basic statistical procedures.

Due to the sheer size of the system (with all the options loaded except the mapping module, it requires a whopping 12MB), it will take a few days to learn *SPSS/PC+*. For a nonstatistician, it will probably take months to learn and years to master the wealth of procedures. It rewards the regular user with a system that will solve problems with both speed and accuracy for a variety of special settings.

A system of three files underlies a working session with *SPSS/PC+*: SCRATCH.PAD is the active command worksheet; SPSS.LOG is the record of the session with diagnostics; and SPSS.LIS is the listing of the output from the program as it runs, which can also serve as a backup for printing results after they have been examined.

FACT FILE

SPSS/PC+,
Version 3.0
SPSS Inc
444 N. Michigan Dr.
Chicago, IL 60611
(312) 329-3300

List Price: $795 for the base system; extra-cost options available.

Requires: 512K RAM for base system, 640K RAM with *Advanced Statistics* and *Trends* options loaded; hard disk with 4.5MB free space for base system installation (11.6MB required for entire system), DOS 2.0 or later. CGA required for *Microsoft Chart* and *Graph-in-the-Box*.

In Short: *SPSS/PC+* is an adaptation of a well-seasoned mainframe program. A full-featured statistical package, *SPSS/PC+* boasts an interactive system of menus and help screens as well as interactive execution. Its chief drawbacks are its price and the size of the system (about 12MB). The documentation and manuals are first-rate. Not copy protected.

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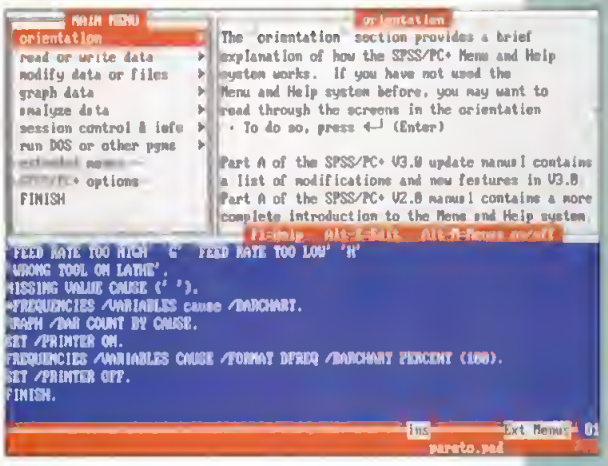
Writing programs in *SPSS/PC+* is easy—in fact, it's much easier to develop programs in *SPSS/PC+* than in the mainframe version of the program. The program has been adapted to take advantage of the PC environment. It uses extensive menus and gives you the ability to paste commands into the working area of the program, which is called SCRATCH.PAD rather than looking up commands and options in the manuals.

However, losing your work is also easy. The three files with default names—SCRATCH.PAD, SPSS.LOG, and SPSS.LIS—are automatically lost unless they are renamed before entering the program again. The user is free to rename these files after exiting *SPSS/PC+*, using the available tools, but the program doesn't manage a system of file maintenance and backups. Someone new to the program could easily lose hours of work because of a failure to save these files under other names.

New features added in Version 3.0 include Flip and Autorecode, which facilitate data management; statistical methods such as rank, nonlinear regression, and log-linear; and the Examine procedures for



SPSS/PC+ lets you tailor the user interface. Windows can be resized and repositioned; any window can be enlarged to full-screen. You can choose among showing the menus, context-sensitive help screens, the command file, and the results of your analyses. The default setting is shown here—menus and help screens on the top half of the screen, commands in the lower half of the screen.

exploratory data analysis (stem-and-leaf, box plots, and so on).

In both the marketing research survey and the social science research tasks, *SPSS/PC+* produced sophisticated cross-tabs and reliability procedures efficiently and quickly. However, the data-cleaning task called for in the social science research task could not be accomplished directly. *SPSS/PC+*, unlike the mainframe version, does not have procedures for converting alphanumeric codes into numerics (Convert on the mainframe is a common way to deal with data-entry errors). An add-on option, Data Entry, affords some control over the entry of illegal characters in numeric fields, range checking, and logical rule checking.

SPSS/PC+ easily performed the time-series analyses required for the financial forecasting task. Although the program lacks the Modulo function required to perform the biology research task (only Modulo 10 is available), we constructed a substitute function by using a bit of algebraic dexterity with the Trunc function, which produces the integer part of a number. And the package has no built-in procedures for the x-bar chart requested by the quality control engineering task.

Presentation-quality graphics, tables, and maps are available in several add-on options: *Tables* from SPSS, *Microsoft Chart*, *Graph-in-the-Box* from New England Software, and Ashton-Tate's *MapMaster*.

The documentation and other texts included with *SPSS/PC+* are superb, continuing the product's mainframe tradition of excellence. The tables of contents are helpful in locating answers to most of your questions. The major manuals are divided into three parts: Introduction and Tutorials, Statistical Manual, and Command References (including pull-out reference cards). Discussions of data modification, procedures, or statistical analyses are clear both to newcomers and experienced users.

User support for the program is professional and knowledgeable. SPSS offers a special "hotline" service at extra cost to "Value Plus" or "Customer EXPress" customers. It includes an 800 number and extended hours for calling. Our questions about time series or quality control were referred to experts in the areas.

SPSS/PC+ is a rich package. The complete system includes just about anything a professional statistician might need. But its menu system, context-sensitive help screens, Fast Start on-line tutorial and excellent documentation make *SPSS/PC+* a system that even a non-Ph.D. statistician (or even nonstatistician) can get great results from.—**Leonard M. Naphtali and Zvia Segal Naphtali**

Stata

What *Stata*, $595 from Computing Resource Center, does, it does very well. And while there are many things that the package does *not* do (numerous statistical procedures are lacking) one can use the package's full programming language to add any of these features.

Stata, Version 2.0, is primarily oriented to general linear-model types of analyses, especially those using continuous variables. For example, regression, analysis of variance, logit and probit models, and Cox-type survival models are all readily available and easy to use. However, there is no ability to do log-linear analysis of multiway tables.

Stata allows you to choose the type of interface you're most comfortable working with: you can use the package either as a menu-driven program, a completely interactive system that optionally keeps a log of all input and output or just all input, or you can configure it as a batch program, using your own editor to write the command files. The program includes a very extensive on-line help system that covers not only the built-in commands, but also most of the vendor-written add-on packages. These numerous add-ons are pro-

FACT FILE

***Stata*, Version 2.0**
Computing Resource Center
10801 National Blvd.
Los Angeles, CA 90064
(800) STATA-PC
(213) 470-4341 in Calif., Alaska, and Hawaii
List Price: $595
Requires: 256K RAM, DOS 2.0 or later.
In Short: Offering three different interfaces—menu, interactive or batch processing—and very good analytic graphics, *Stata* excels in regression analysis and many of its relatives (ANOVA, logit, probit, survival analysis). Its weakness is in categorical data sets, including limited cross-tabs. *Stata* is very fast and includes both transformation and data-management capabilities. Not copy protected.

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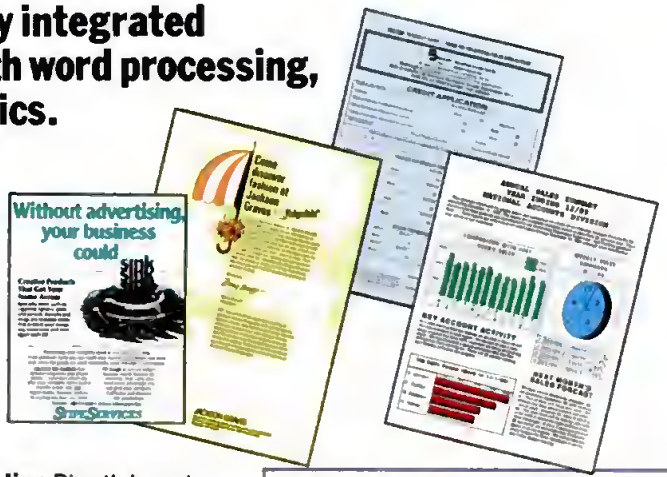

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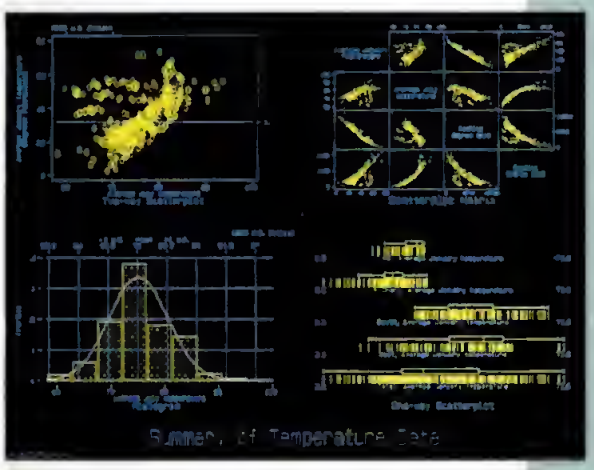

Stata's graphics versatility is apparent as it displays four unique graphs. It can also create multidimensional graphs.

grams written in *Stata*'s programming language. They are supplied automatically, both as extensions of *Stata*'s statistical capabilities and as examples of how to write such programs.

The graphics capabilities of *Stata* are very good, although they are not as dynamic as those from *NCSS*. One problem with the graphics is the limited control the user has over where labels and titles can go. Furthermore, the user is not given any font choices. Still, the graphics are very useful for analytic purposes, and the results are of presentation quality, with support for many output devices.

Stata boasts numerous unusual graphics options, including scatterplot matrices—a set of two-way scatterplots arranged in a matrix—and two types of multiple imaging. The first type allows you to use one variety of a graph with a "by" statement so that on a single screen you can see separate graphs of, say, income by experience for females, for males, and for both. The second type allows you to combine different varieties of graphs on the same screen or printout. Thus, you could show a bar graph, a box-and-whisker plot, a one-way scatterplot and a normal curve plot all at once. You could even merge this with two- and three-dimensional graphs.

Although the program is not really aimed at quality control applications, several vendor-supplied programs furnish many of the most-needed charts, including those specified in the quality control engineering script. Of the four tasks that *Stata* could do (the package doesn't include ARIMA analysis, so the forecasting task was not attempted), the only problems occurred with the social science research task, since the program doesn't have reliability analysis.

Stata is very limited in terms of its ability to turn output into presentation quality. While there are some provisions for adding user and job information and highlighting various parts of the output, there is no way to place pieces of the output in particular page locations.

One of the best features of *Stata* is its flexibility. Not only does the package offer both a programming language and a separate macro facility, but there are also specific commands that enable users to easily do things that are not obvious and that other programs don't allow. For example, following a regression, an ANOVA, and a logit, probit, or Cox regression, one can easily design and test linear hypotheses. Furthermore, the regression procedure automatically provides significance tests of each independent variable.

Often a user will want to test sets of variables, such as those that together comprise the categories of a classification variable. *Stata* allows this. Alternatively, one may want to test whether one coefficient is equal to another (or to two or three times another). This is also very simple. Further, *Stata* guards against the user specifying inconsistent constraints. Thus, you cannot test at the same time whether a particular coefficient is equal to both 20 and 21. It is also easy to automatically form dummy variables from a categorical variable.

The manual is generally clear and well integrated, though it would be helpful if page numbers, rather than just subject titles, could be included. The inclusion of cross-references would also be welcomed. The major weakness of the manual is its lack of technical material: no references are listed, and computing algorithms are not discussed.

The company's technical support was excellent, and whenever serious bugs are found, new disks are sent out to all registered owners—an excellent practice.

—Richard Goldstein

Statgraphics

Brilliant graphics and extensive statistical and mathematical functionality are the twin stakes upon which *Statgraphics*, from STSC, has layed its claim to the PC statistical software market. With Version 3.0, STSC has strengthened an already robust product, adding HPGL support to its graphical capabilities, significantly extending its quality control procedures,

FACT FILE

Statgraphics, **Version 3.0**
STSC Inc.
2115 E. Jefferson St.
Rockville, MD
20852
(301) 984-5000
(800) 592-0050
List Price: $895
Requires: 512K RAM (640K recommended and required for some procedures), CGA, DOS 2.0 or later. Hard disk recommended.
In Short: *Statgraphics* is a versatile, flexible package with emphasis on graphics. It can be customized and extended through its interface to APL*Plus. Version 3.0 transcends many of the program's previous limitations.

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A Day in Five Lives: Biological Research

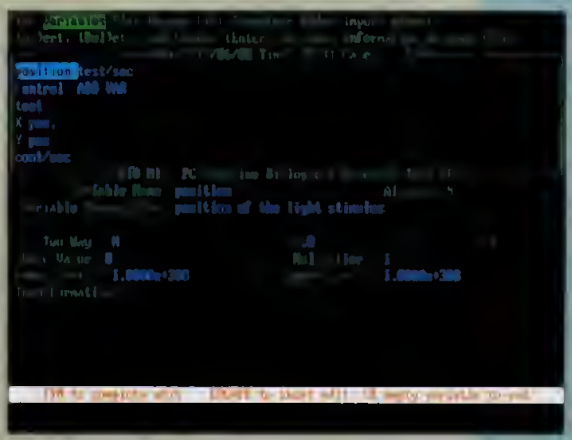
Task 1

For our first task, we chose an example from a neurobiology research lab. Seventy-six flashes of light, administered along a matrix of spatial locations, were presented to an animal while electrical recordings of a single neuron in the animal's brain were recorded.

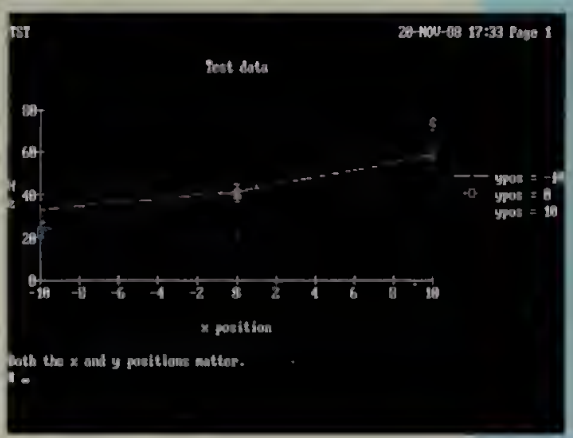
Each reviewer received a data file of the 76 responses to the stimulus, based on the position of the stimulus. Data for the activation of the neuron for 0.5 seconds preceding and following the light stimulus were called the Control and Test responses, respectively.

To analyze the data, we

- performed a data transformation to generate data that represented the position of the stimulus;
- sorted the data based on the position of the stimulus;
- converted the data to a different scale;
- performed a two-way analysis of variance (ANOVA) to determine whether the Control response and the Test response were dependant on any of the given stimulus conditions, and to determine any interaction effects;
- performed a linear regression to determine the parameters of the response to the stimulus;
- graphed the results as a contour graph;
- determined the feasibility of using a programming language or macro facility to automate the task for multiple test sessions.



The variables for the biological research task are defined in *Microstat II*.



RS/1 plots the effect of both the *x* position and *y* position of the stimulus as it affects the firing activity of the neuron. *RS/1* can also present these results in a 3-D graph.

doubling data size limits, and completely overhauling its custom procedures interface. What's more, they have done it while keeping the price at $895 (an upgrade from Version 2.6 is $195; from earlier versions, $395.)

A new, menu-driven installation procedure allows easy customization of graphics output for a wide variety of printers and plotters, as well as for the Polaroid Palette film recorder. Also new with Version 3.0 are instructions for installing *Statgraphics* on a network. While file and record-locking are not available, data can reside on either the workstation or file server. System and help files are installed on the server and can be shared among concurrent users.

Installed and customized for your PC, *Statgraphics* is ready to tackle data. The program can import and export ASCII, .WKS, .WK1, and .DIF files, among other standard PC formats. Full-screen browse and edit capabilities allow you to examine and clean moderate-sized files. Larger files, however, may need to be split by rows or columns to be manipulated; in particular, no more than 127 columns of a .WK1 or .WKS file can be imported at once. But you can join files without limitation inside *Statgraphics*, and import/export procedures are so friendly that even a massive spreadsheet is soon digested.

Each time it is loaded, *Statgraphics* creates a data directory in RAM to speed subsequent file access. Thus while the initial program load takes about ½ minute on an AT, subsequent access to all data files in the directory is quite fast.

You can manipulate data, whether im-

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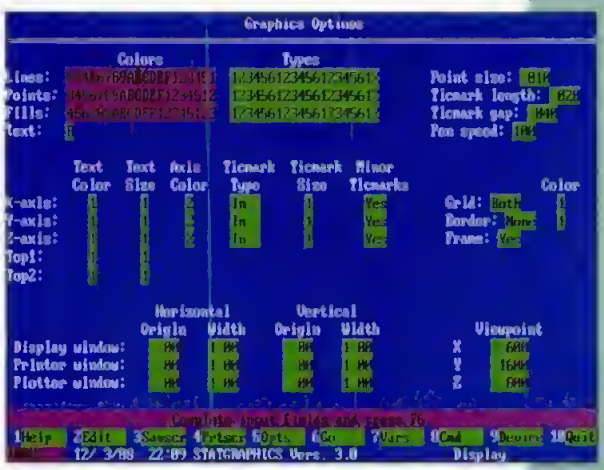

Statgraphics provides incredibly detailed worksheets, giving users considerable freedom for specifying graphics options.

ported or created in *Statgraphics*, with the full-screen text editor and by using what *Statgraphics* calls *operators*. Operators include a wide variety of generalized mathematical functions with names like Compress and Reshape. Most of the operators, which cover functions for APL programming language primitives, are defined on matrices; this vastly simplifies data manipulation. You can access the operators from any input panel or from the "execute window," a pop-up window that provides a powerful interactive data management facility.

With well over 200 statistical and mathematical procedures, *Statgraphics* fits anyone's definition of a general statistical analysis package. It easily performed virtually all of the test tasks including quality control, ANOVA, simple and multiple regressions, and cross-tabulations. Even reliability analysis, a procedure that is not built in, can be performed by a combination of other procedures and use of the operators.

You can write custom procedures for *Statgraphics* using APL*Plus, STSC's implementation of the APL programming language. This feature is extremely valuable for people working with relatively new techniques (like Efron's bootstrap statistics) or attempting to integrate other mathematical models (neural networks, nonlinear dynamics) with those supplied here. The availability of a very high-level set of primitives in APL*Plus allows the mathematics to speak for itself.

Documentation is in general quite good, and examples are plentiful. If little background is given to justify the ways of statistics to users, the procedures themselves are so well laid out that it is hardly missed.

While nearly all of its calculations are performed in APL, much of the screen-handling is written in C—another case of fitting the tool to the task. Almost every screen in *Statgraphics* can be edited and saved. Graphs can be customized, either directly while viewing the screen, or by varying display parameters such as color, type, point size, various tick-mark features, and window size for display, printer, or plotter. You can also specify a viewpoint for 3-D graphs. And not only can you annotate charts while looking at them, you can even plot the next point in a regression or exclude outliers from a calculation and redo the graph, all interactively!

Statgraphics balances beautiful graphics with powerful analytics: this bell curve rings true.—**Marc M. Groz**

StatPac Gold

StatPac Gold, $595 from Walonick Associates, takes less time to learn and costs considerably less than many other statistical analysis packages. It is particularly attractive to those people who are more comfortable with less software between them and the data: minimal disk space and memory are required to run *StatPac Gold*, Version 3.0.

The program's tutorial is an excellent introduction to the program, helpful both in learning about the architecture of the program and how to set it up. *StatPac Gold*'s well-written 538-page manual contains informative discussions of statistical procedures.

StatPac Gold consists of separate programs linked together by a menu system. Many of these programs can be run directly from DOS, bypassing the menu system altogether. Others work together as groups that carry out specific functions. For example, data entry and editing is accomplished by a group of programs, rather than by an individual program. Other tasks carried out by program groups include generating code books, generating and executing procedure files, and file conversion to and from various formats.

The program uses three file types in any analysis: codebooks, data files, and procedure files. Although all are in ASCII format and can be created using any text editor, *StatPac Gold* has specialized

FACT FILE

***StatPac Gold*, Version 3.0**
Walonick Associates Inc.
6500 Nicollet Ave. South
Minneapolis, MN 55423
(612) 866-9022
List Price: $595; with forecasting option, $790
Requires: 256K RAM, hard disk with 1.6MB free space, DOS 2.0 or later. CGA and math coprocessor optional.
In Short: *StatPac Gold* takes up minimal disk space and memory, takes only a short while to learn, but lacks some important procedures. It may be attractive to those who are more comfortable with less software between them and the data. If it does have the statistical procedure that you need, then it may be the package to use. Copy protected; non-copy-protected version available free to registered users.

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programs for creating them. Each time the data is transformed or a new variable is computed, a new data set with a new codebook must be written. Procedure files then refer to the new data set and codebook. This is conceptually simple, but it rapidly proliferates files, and the user must keep track of the sets of three files created at each step.

Writing programs with *StatPac Gold* is fairly easy. The program has a limited amount of automation in the form of help screens, and the ability to paste commands and variables from the menus. The program lacks a macro facility.

StatPac Gold is slow at even the simplest tasks, like recodes or frequencies. A long wait for results is particularly frustrating when you're trying to debug procedures you have written. If you made the mistake of not turning on your printer while debugging your procedure, you must run it again to get a printout. Although the version of the program we reviewed did not support a math coprocessor, Walonick Associates offers a version that does at no extra charge.

StatPac Gold was capable of producing results in four out of the five tasks in our testing script, although at times the route required was tedious and the processing slow. For one thing, it lacks the sophisticated cross-tab and reliability procedures required for the marketing research survey and the social science research tasks; we had to build them from the more elementary procedures the program does have. The program also had difficulty reading the free-field data for the biological research task, but was efficient in the statistical calculations for the task.

Because it lacks procedures for the time-series regression with correction for auto-correlation of the residuals required by the forecasting task, *StatPac Gold* was unable to produce results for this task.

StatPac Gold is somewhat limited in its graphic capabilities. When we plotted the x-bar and r-bar charts for the quality control engineering task, they were compressed on the left of the scale, because the horizontal scale cannot be adjusted to the amount of data available. And the chart cannot then be edited to look better. Contour plotting is not available.

I used the technical support 800 number whenever I encountered difficulties and found the responses to be courteous and knowledgeable. Often it was David Walonick, the developer of the program, who came to the phone to answer our questions.

Unfortunately, the program implements a form of copy protection that restricts the user to three installations: one in the office, one at home, and one in case of a hard disk crash.

StatPac Gold is not a full-featured statistical software package. It lacks certain procedures, making the package less versatile than *SPSS/PC+*, for example. However, it is easy to learn and doesn't gobble large chunks of your hard disk. If it has the statistical procedures you need, it is recommended.—**Leonard M. Naphtali and Zvia Segal Naphtali**

Systat

Before reviewing any software for this article, I did some dreaming about what the perfect statistical analysis program would contain. It would contain a spreadsheetlike data editor for ease of data entry and manipulation, but it would also be able to import, transform, and export data in a command-driven way. It would have every statistical analysis function I could think of—and a few that I couldn't. To be truly powerful, it would have a full-featured programming language so that complex repetitive functions could be automated. It would make beautiful graphs—even maps and Chernoff faces. And, if it wasn't too much to ask, it would have great documentation.

Systat, $795 from Systat, comes in a two-volume package (with both *Systat*, Version 4.0, statistical analysis software and *Sygraph* graphing software) and is the closest thing to the ideal statistical analysis package I've come across. And while each volume can be purchased individually, the complete package is available at a price that makes purchase of the complete system an attractive option. Numerous add-on packages to enhance *Systat* are also available, ranging from *Mystat*, a low-budget personal statistics package; to logit, probit, and survival analysis packages. These add-ons are priced from $30 to $120. Macintosh versions of many *Systat* programs are also available.

Installation of *Systat* is a little strange. The programs come on-disk in compressed form, and the install program decompresses them; like a dry sponge that gets wet, *Systat* expands to gobble up 4.5MB of hard disk space. You could run *Systat* on a dual-floppy-disk machine, but it would take 15 disks for the statistics portion alone.

Systat was designed with the user in mind. Commands are simple and English-like. In most cases, the simplest version of a command is all you need. If you need something more specific, a variety of options can be added to the command to give it more detail. You can make a no-frills histogram or generate a modest set of statistical data about any file with a single-word command. Furthermore, *Systat* commands come in two varieties: hot and cold. Cold commands are stored and moderate a subsequent hot command. Hot commands are executed immediately. I found this to be an intuitive way of managing the programs.

Systat has not pursued ease of use at the expense of statistical power. Just about every feature on our features table is supported, and most can be executed with a simple series of commands that can later be refined with command options. Importing the data for the quality control engineering task and generating histograms and control charts was accomplished with startling

FACT FILE

Systat, Version 4.0
Systat Inc.
1800 Sherman Ave.
Evanston, IL 60201
(312) 864-5670

List Price: For two-volume statistics and graphics system, $795; for *Systat* statistics package alone, $595; for *Sygraph* graphics package alone, $495.

Requires: 640K RAM, DOS 2.0 or later.

In Short: *Systat* is a well-rounded package with just about every imaginable statistical function, as well as a good user interface, excellent documentation, and beautiful graphics. Not copy protected.

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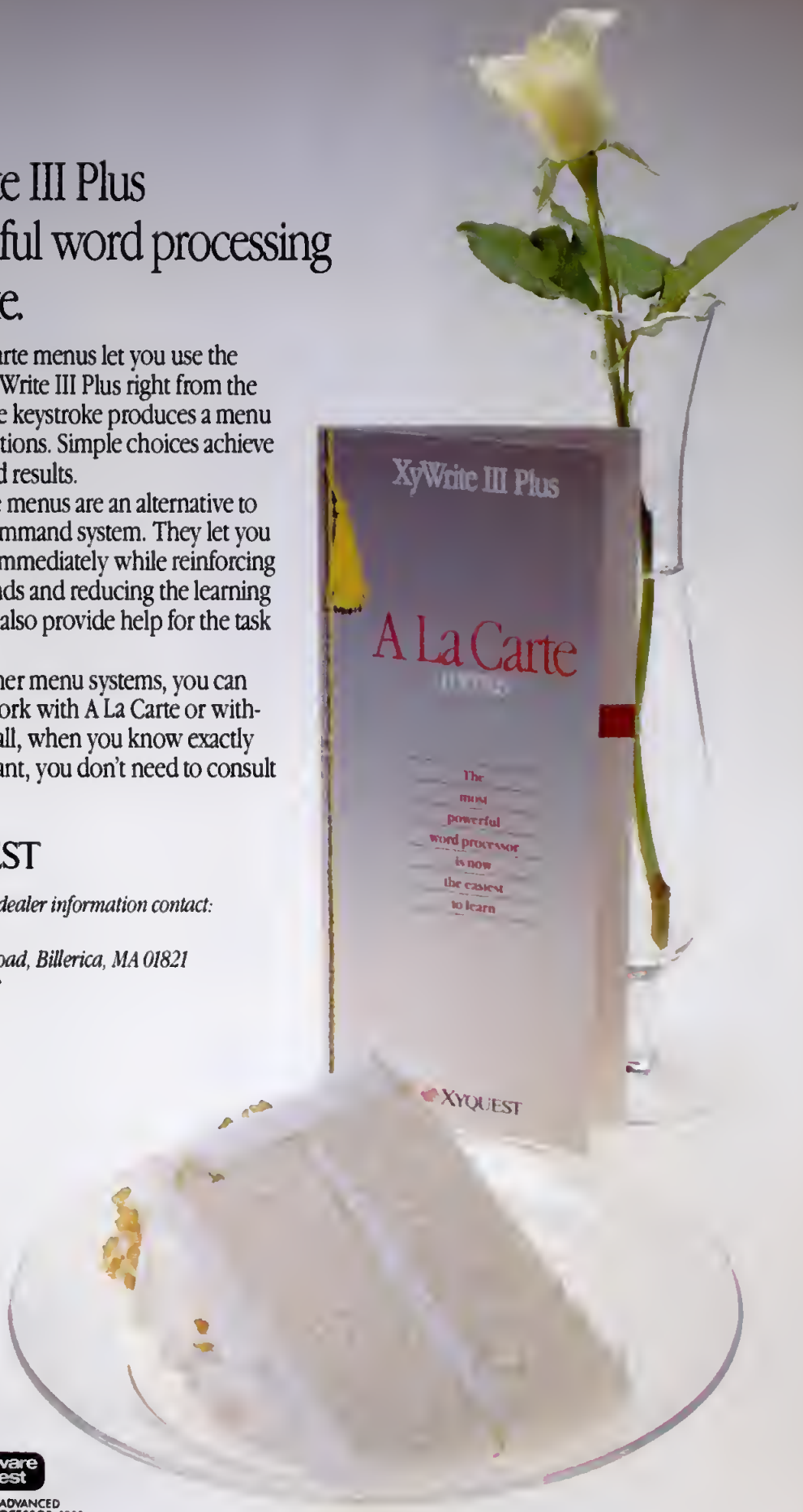

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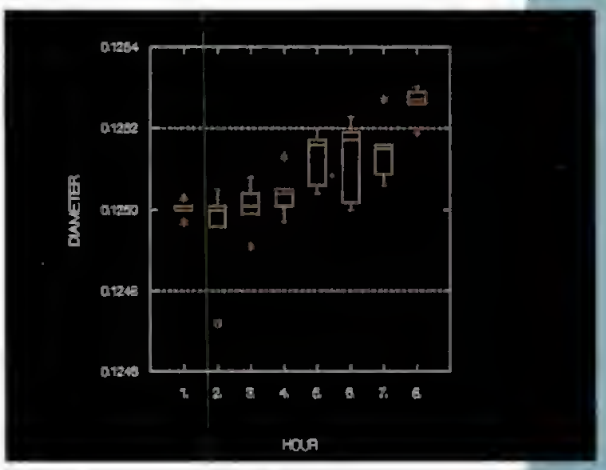

Using the graphics capabilities in the *Sygraph* module, *Systat* generates a quality control box-and-whisker plot. Note the control limit lines and the out-of-control points.

ease. The data for the biological research task was slightly more difficult to import because of the complex data transformations. However, the command language helped to accomplish the importation with little pain.

Using the *Sygraph* software, I was able to generate a series of attractive graphs. *Sygraph* came in handy with the marketing research survey task—the graphics it generated were so attractive that I could easily imagine feeling comfortable trying to impress a tough board of directors.

Constructing the data-cleaning routines for the social science research task was not particularly difficult. Because *Systat*'s general execution of a command is usually sufficient, it was easy to create correlation data. Likewise, developing the ARIMA model for the forecasting task was relatively easy, particularly with the good examples and gentle teaching style of *Systat*'s manual.

The manuals for *Systat* deserve special kudos. Each of the two principal components have a thick three-ring binder with numerous examples and sample command executions. There are many references to the "large literature" on statistics. In fact, the manuals admonish that "you really should read some literature" on the subject.

Yet there are some problems with *Systat*. The program seems a little slow, perhaps because of its extensive functionality, and the installation modified my AUTOEXEC.BAT and CONFIG.SYS files, although it did warn me beforehand and saved a backup copy of the original files. The software includes a command reference book, but at 90 pages it was not the quick reference I was looking for. I was also surprised at the absence of a native Pareto chart for the quality control engineering analysis. I had to use two steps—sort, and then generate a histogram—to get the job done. *Systat* has made me lazy.

Systat's $795 price tag may put some people off. But compared with other products reviewed in this section, and in terms of what you get for what you pay, this package is unbeatable.

—Martin L. Ramsay

Turbo Spring-Stat

An exciting reality of the computer business is that one person can create quite an impressive program. The downside of single-person software efforts is that they can be marred by the very force that created them. *Turbo Spring-Stat*, $469.95 from Spring Systems, has both the benefits and the shortcomings of being one person's concept of just what a statistics program should be.

Overall this is a powerful statistical analysis program with a nice data-management facility, a powerful editor, and an expert system to help you decide what statistical procedure to use. In addition, it includes a wide selection of statistical manipulation and analysis tools. *Turbo Spring-Stat*, Version 2.9, is marred by a password system, and doubly so since the system can bomb if you have a math coprocessor, an undocumented and to-date uncorrected bug. Unfortunately, only the author is available for customer support.

If you can get around these problems, *Turbo Spring-Stat* includes a lot for the money. Spring Systems positions *Turbo Spring-Stat* as much easier to use, much more affordable, and about as powerful as some of the heaviest-hitting stat programs on the market. The programmer and author of the documentation, John Pavasars, emphasizes data handling, user interface, and cost as three areas in which his program excels.

Turbo Spring-Stat's data manager, a standalone flat-file manager; the text editor, which uses *WordStar* control-key commands; and the transform module, with its variable creation, recoding, and transforming powers, combine to give you great flexibility in setting up new data files or working with existing files.

Besides using color, the program uses both horizontal and pull-down menus. While you can activate options on the horizontal menus with single-key commands

FACT FILE

***Turbo Spring-Stat*, Version 2.9**
Spring Systems
P.O. Box t0073
Chicago, IL 60610
(312) 275-5273
List Price: $469.95 for full set of 20 modules. Each module available separately for $39.95.
Requires: 385K RAM, DOS 2.0 or later. Hard disk recommended.
In Short: *Turbo Spring-Stat* consists of 20 separate modules, including a database manager, text editor, and mini-expert system, as well as modules for different types of statistical analysis. Although it has a pleasant user interface, the program is marred by an obtrusive password system that doesn't work with a math coprocessor. Not copy protected.

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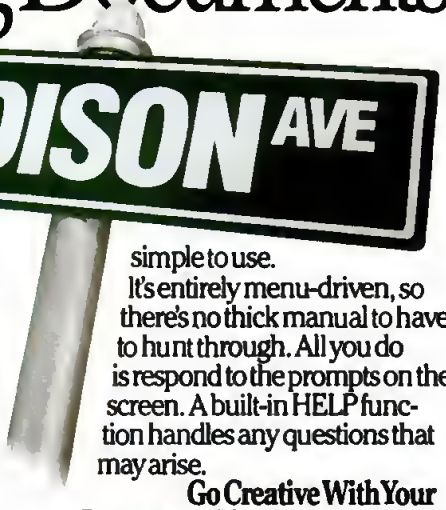

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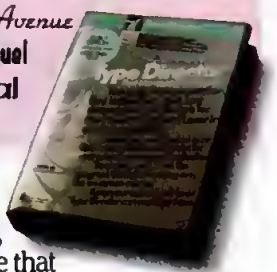

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CIRCLE 200 ON READER SERVICE CARD

PC MAGAZINE EDITOR'S CHOICE

- SPSS/PC+
- Statgraphics
- Systat

If you're serious about your statistics, no one package is going to fit the bill. One package's pinnacle procedure is another's albatross, and statisticians are forever package-hopping to get their work done. Yet, when you speak about general ease of use, breadth of features, and robustness of data-handling capabilities in the same breath, some clear winners emerge.

SPSS *has become an institution in the mainframe world, especially in the hallowed halls of research and academia. Its PC offspring,* SPSS/PC+, *while it does not offer the complete functionality of the mainframe version, transforms the PC into a cornucopia of statistical know-how. Better yet,* SPSS/PC+ *optimizes the PC environment and produces great output. Interactive menus and interactive execution cut this enormous package down to a manageable size. The documentation is a pedagogical adventure; the charts and tables are first rate; the data handling commendable. However,* SPSS/PC+ *is weak with data management (it's difficult to move between levels), and with ANOVA regression.*

Systat *excels with linear models—such as ANOVA regressions—areas in which* SPSS/PC+ *languishes. Systat was developed on a PC, and its smooth and powerful command language reflects its origins; you can get a lot done with a single command.* Sygraph, *its companion graphics module, gives the package a fabulous graphics edge and should be considered a must.* Systat, *incidentally, is weakest in areas such as cross-tabs, where* SPSS/PC+ *excels.*

Statgraphics, *born on a PC for PC users, sports a user interface to be proud of. Its graphics will knock your socks off; its menus have a depth to them that most menu-based packages can't begin to approach. Most of the program's previous limitations, which earned it a reputation for being in the "bush leagues," have been overcome in Version 3.0.*

One thing's for sure: statistical software is an extremely fluid arena. While we didn't give them editor's choices, two packages we reviewed have good potential and are worth keeping an eye on. These packages are somewhat limited in their capabilities, but are very good at what they do. Stata *provides solid regression procedures and admirable graphics. It's fast and offers both menu and command interfaces. And finally, despite its quirks, we were intrigued by* NCSS's *unique panel interface, which lets you specify reusable command sequences one panel at a time.*

or by moving the cursor to the option, pull-down menu selections require you to move the cursor to the desired choice.

If you're going to use *Turbo Spring-Stat*, you need to understand how its author uses the various program modules and what the program demands in terms of file formats and file extension names. A small box on-screen displays prompts and context-sensitive hints to help you out.

Turbo Spring-Stat's expert system asks a series of questions requiring yes or no answers. Each session is termed a consultation, and each consultation concludes with a suggested statistical procedure based on your answers to the questions.

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CIRCLE 194 ON READER SERVICE CARD

● ADVANCED

You don't have to spend a lot of money buying unnecessary parts of the program. We worked with the full system of 20 modules, which costs $469.95, but you can buy selected modules for $39.95 each, saving both money and disk storage space (the full system takes up just over 2¼MB). This salad-bar approach to buying software is a boon, especially for those whose needs are defined and relatively fixed.

Spring Systems offers a free demo disk that shows how the user interface works and some of the modules in action, including the graphics and expert-system modules. This demo disk is for examination only and may show you all you need to see to decide if the program is for you. The demo documentation includes information on which combinations of modules are needed for various statistical analyses.

Turbo Spring-Stat has problems, but it includes a lot for the money.

Turbo Spring-Stat's output is limited to ASCII graphics. The author takes a stand about graphs for analysis, not presentation, perhaps missing the point that good-looking graphs can make analysis easier. You're limited to two- and three-dimensional maps, scatterplots, frequency plots, box plots, and stem-and-leaf diagrams. The downside of ASCII graphics is that they don't look very good. The upside, however, is that ASCII graphics can be edited very easily with any text editor, and printed on all PC printers.

The full system has lots of power, but you can choose to purchase only the parts you need and save a lot of money. If you can live with the realities of a program written, documented, and supported by one person, *Turbo Spring-Stat* might be a good program to look at.—**Bruce Brown**

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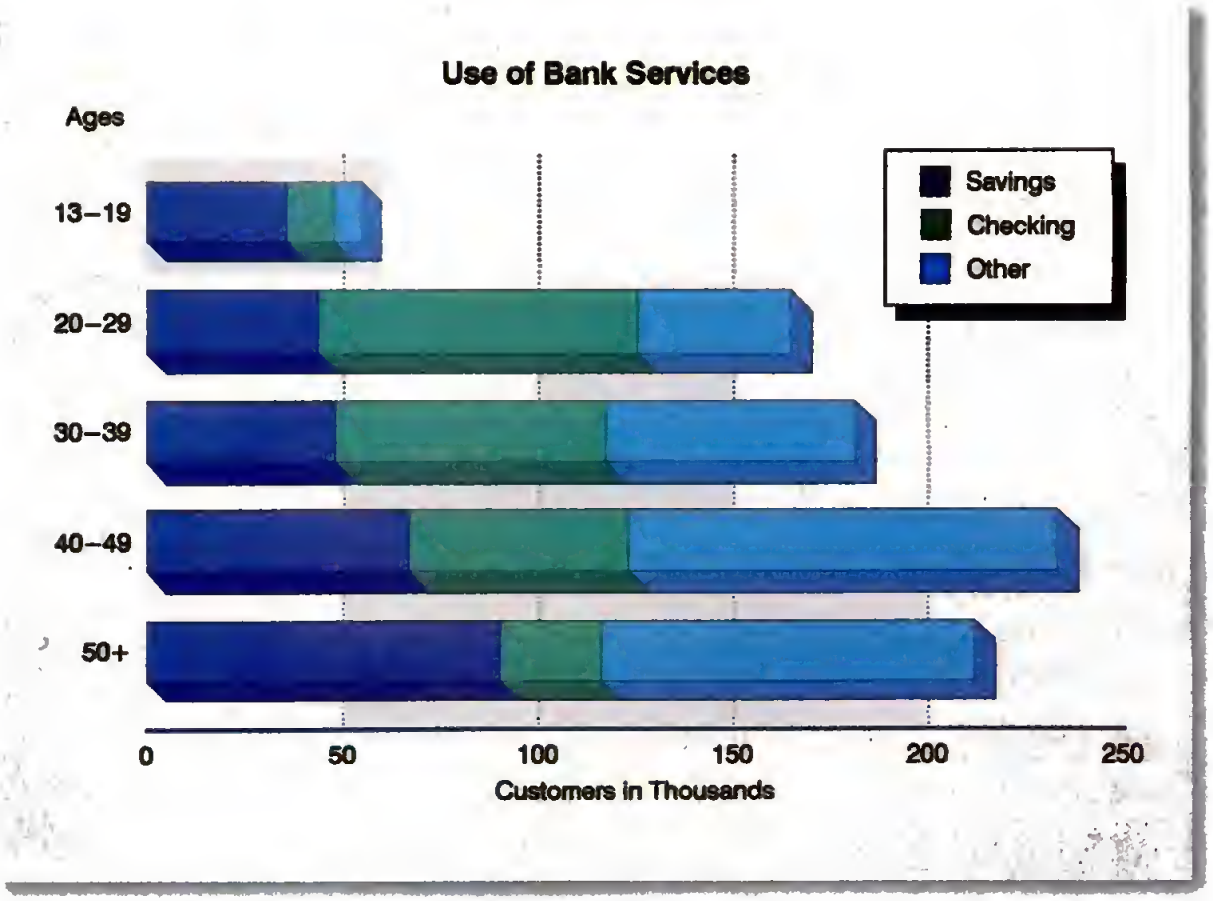

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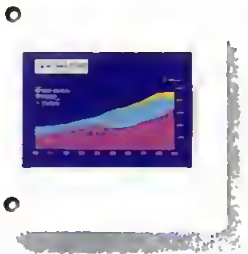

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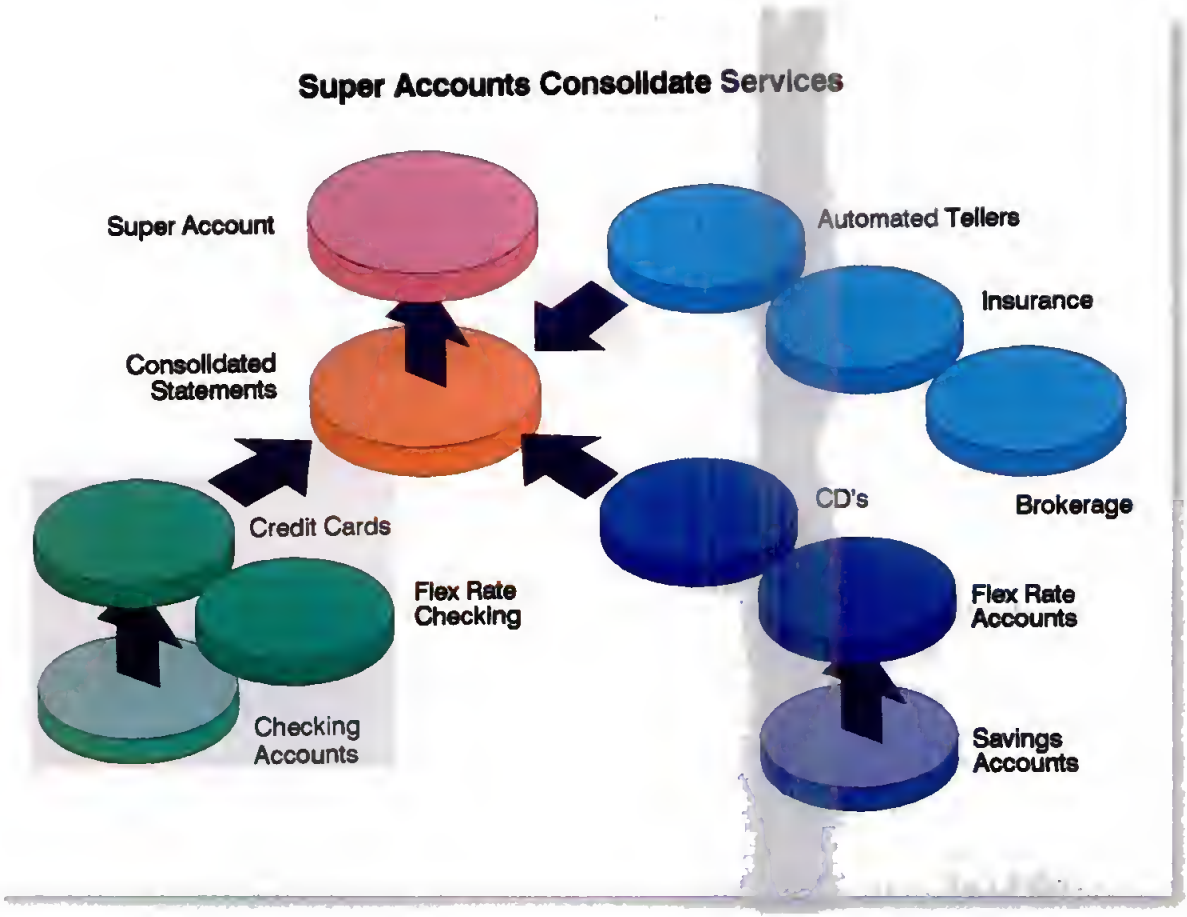

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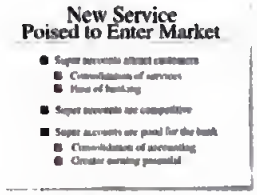

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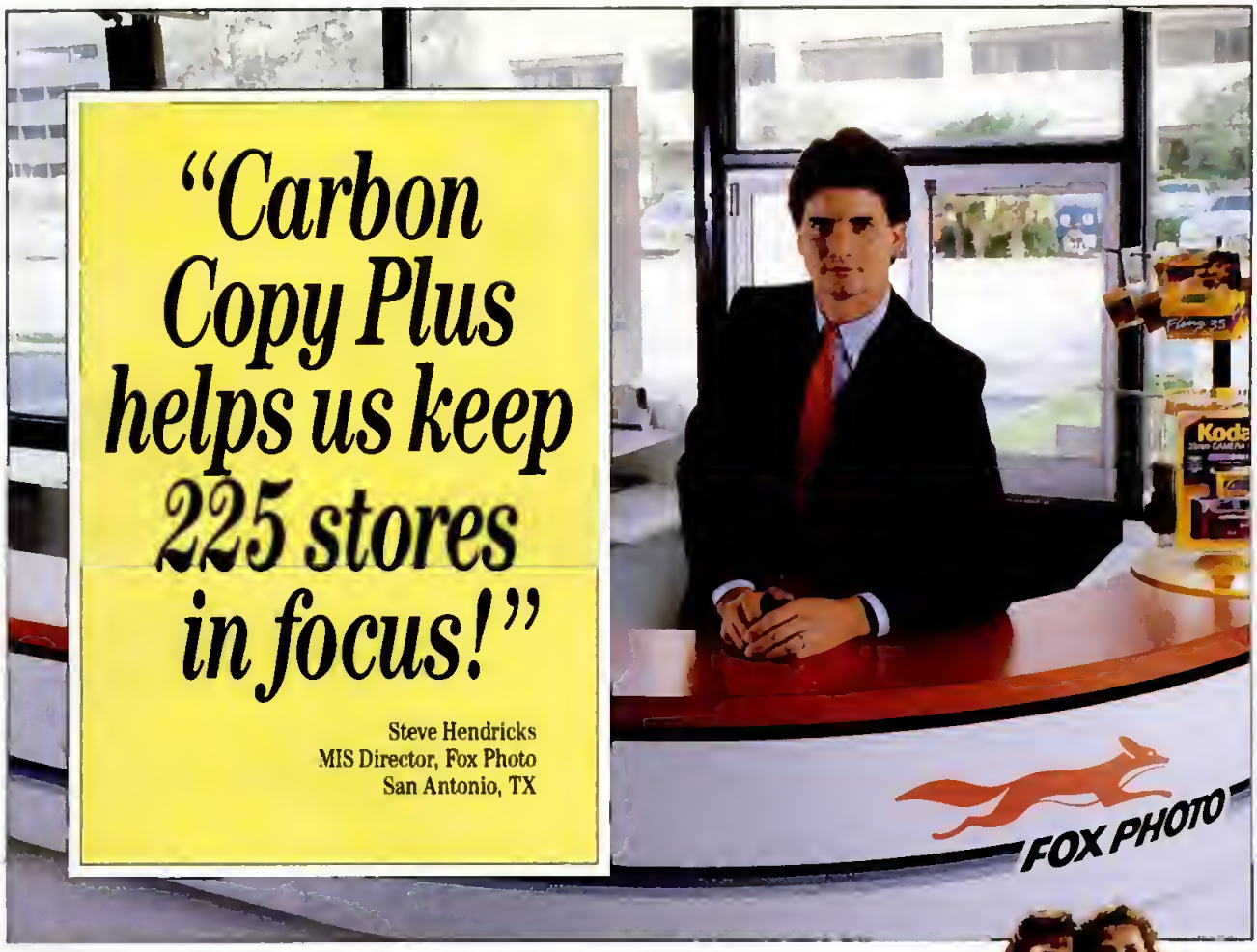

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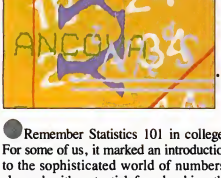

BASIC

Remember Statistics 101 in college? For some of us, it marked an introduction to the sophisticated world of numbers, charged with potential for plumbing the depths of what a set of numbers might hold. For others, it marked the end of a road. But for those of us who stumbled on, hoping to find signposts along the way, help is in sight. Many users won't require any more statistical muscle than what's found in these basic statistical analysis packages. These compact, often relatively inexpensive programs parallel much of that Stat 101 curricula.

The basic statistical tools they feature cover a variety of fundamental statistical procedures, some with more depth than others. However, the stat packages reviewed in this section share a common baseline performance criteria. They import and export ASCII files, although some stumble on subtleties, such as delimited vs. free-field ASCII. They calculate means and typically offer a fair smattering of other descriptive statistics—for example, standard deviations. All allow some rudimentary graphics: they can diagram histograms and scatterplots. And they all perform linear regressions and typically incorporate analysis of variance procedures.

ABstat

A statistical package that takes mere minutes to learn may make certain novices happy, but intermediate users may wince at many options that *ABstat*, Version 5.10, lacks. *ABstat*, $395 from the Anderson-Bell Corp., provides easy access to basic statistical functions such as cross-tabulations, correlations, linear regressions, and standard parametric and nonparametric measures. More-specialized functions (as well as multivariate and two-way variance analysis) are missing. However, if you are in a rush for simple data analysis, *ABstat* lets you bypass complex commands to get results quickly and efficiently.

From *ABstat*'s main menu, you enter the abbreviations to select general procedures such as data manipulation, statistical analysis, graphic functions, or report writing. From the general procedures menu you then select a specific task by entering its name. On-line help, available for some procedures, is lacking for some of the more complex operations. The noninteractive on-line tutorial, which provides only an outline of some of the program's functions, is useful but not at all comprehensive.

The elementary graphics feature includes line and bar graphs, scatterplots, and pie charts in high-resolution graphics (CGA, EGA, VGA, or Hercules). Since you cannot customize the individual sectors in a plotting range, the graphics capability is unsuitable for formal presentation.

This program's best feature is the fast and straightforward data-entry procedure. Data importing in *dBASE*, *Lotus 1-2-3*, or ASCII format takes only a few keystrokes and avoids many of the redundant commands present in more-sophisticated packages. The most-efficient method is to enter the variable names on the first lines in an editor and let *ABstat* read them automatically. This feature is a great time-saver because it eliminates the repetitive aspect of importing data.

You will need a user manual nearby when running *ABstat*. Although this software is not copy protected, it will occasionally require you to verify that you have the manual in your possession by requiring you, on a weekly basis, to enter a code that you find in the manual. If you don't have the correct system date on your computer, you'll have to perform this chore every time you operate the program. Technical support is unlimited and usually available instantly, but it is not toll-free.

ABstat is a compact (only two disks) but rudimentary package with a narrow range of statistical functions. However, the flexible menus and terse commands make this software extremely simple to learn. If you're not a professional statistician and don't want to invest time and effort to learn a more complicated package, *ABstat* may fit your needs.

—Wendy **W. Huang**

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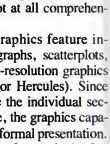

***ABstat*, Version 5.10**
Anderson-Bell Corp.
11479 S. Pine Dr., #460
Parker, CO 80134
(303) 841-9755, ext. 58
List Price: $395
Requires: 256K RAM, DOS 2.0 or later.
In Short: *ABstat* is written in Turbo Pascal and offers only basic statistical procedures, but it is one of the easier statistical packages to learn and comprehend. Designed for the nonspecialist. Not copy protected.
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Crunch Statistical Package

Sometimes a name says it all, and that's pretty much the case with *Crunch*, from Crunch Software Corp. Although not exactly perfect, Version 3.11's number-crunching prowess and ease of use make it appealing for a variety of statistical analysis applications.

Because of its reasonable price, $495, and powerful data-transformation capabilities, *Crunch* should appeal most to researchers in the social and biological sciences. Its rudimentary graphics and lack of time-series analysis, though, make it less attractive for most business applications.

Crunch is made up of a number of programs written in compiled BASIC that are

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***Crunch Statistical Package*, Version 3.1**
Crunch Software Corp.
5335 College Ave., #27
Oakland, CA 94618
(415) 420-8660
List Price: $495
Requires: 256K RAM, BASIC interpreter, DOS 2.1 or later.
In Short: Written in compiled BASIC, *Crunch* is a fairly comprehensive statistical analysis package with an outstanding data-transformation routine. Its performance is hampered by crude graphics and lack of time-series analysis procedures. Copy protected (non-copy-protected version available at no extra charge directly from company).
CIRCLE **693** ON READER SERVICE CARD

all tied together by a central control program. One annoying result of this is that selections from the utility or statistics menus can't be made by merely highlighting the name, but rather the full program name must be typed in for each function.

Another minor annoyance is that each time a different statistical parameter is changed, the entire data file must be read from the disk again. Furthermore, *Crunch* does not support numeric coprocessors, which could speed up its calculation times considerably. The program has a batch file function that can be used to automate repetitive tasks, though, making this less of a problem.

One area where *Crunch* really stands out is in importing data from other sources such as ASCII, *dBASE*, and .DIF files. All that is required is to specify the starting and ending column positions for each variable, and the records are imported with alacrity. A file containing 1,000 records of just one variable took only 5 seconds to be converted to *Crunch* format. For those occasions when data is to be entered directly, there is a rudimentary editor.

Data transformations are handled in a novel fashion that makes the operation a piece of cake. After one or more expressions are entered exactly as they would be in a BASIC program statement, the BASIC interpreter is invoked and the results are stored in a new file, thus preserving your original data.

Graphics output is mediocre at best and, in some cases, nonexistent. Because *Crunch* uses the IBM block character set, it does a great job of producing two-color bar charts and histograms (which can be scaled automatically or manually), but for instances where sinusoidal representations are called for, be prepared to spend another $350 for Crunch Software's optional *Sigma-Plot* module. *Sigma-Plot*, reviewed elsewhere in this issue, produces EGA-quality graphics and outputs them to the monitor or to an Epson or IBM printer.

The manual supplied with *Crunch* is quite thorough, although a bit overly technical and confusing at times. The section on analysis of variance, for example, is so perplexing that further explanation and a number of examples are contained in a file on one of the disks. Fortunately, registered users are entitled to unlimited telephone support.

Finally, though *Crunch* uses key-disk copy protection, it is only a temporary irritation. Just sign the agreement in the package requiring relinquishment of your first-born if you get caught making an unauthorized distribution copy, and an unprotected copy will be sent at no charge.
—Frank Bican

Decision Graphics

When a statistician first sits down with *Decision Graphics*, $450 from Samna Corp., he or she may be disappointed with the statistical processing capabilities of the package. Disappointed, perhaps, but not surprised. Because while it does have some facilities that can also be found in the so-called general-purpose statistical programs, *Decision Graphics*, Version 3.1, is intended to be used primarily as a business graphics package with an emphasis toward data having a time basis (such as sales data).

From the very first session, users will find *Decision Graphics* to be one of the more thoughtfully designed statistics programs. Installation of the software is both quick and painless, and a wide range of

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***Decision Graphics*, Version 3.1**
Samna Corp.
5600 Glenridge Dr.
Atlanta, GA 30342
(800) 831-9679
(404) 851-0007 (in Ga.)
List Price: $450
Requires: 256K RAM (384K with EGA card; 640K with VGA or EGA with high-resolution monitor and 16 colors), hard disk (with 1.2MB free space), DOS 2.1 or later.
In Short: Written in compiled BASIC, *Decision Graphics* is a presentation-quality business graphics package with limited database and statistical capabilities. Not copy protected.
CIRCLE **692** ON READER SERVICE CARD

monitors, mice, printers, plotters, and slide equipment is supported to facilitate the production of charts and graphs for presentations. The package runs either menu-driven or via macro commands; thus, both new and experienced users will feel comfortable. And as with all products from Samna, knowledgeable help is only a phone call away.

Still, there are problems. *Decision Graphics* has limited database capabilities—a maximum of 1,500 data points can be retained in memory, and basically the only way to edit or subset the data is by hand. Data screening is difficult because the package doesn't include a univariate frequency procedure. Furthermore, alphanumeric data may be used only as labels; arithmetic and time-series transformations may be performed along with some simple statistical functions; and recodes are not supported. Also, while on the subject of features not supported, it should be noted that several basic but important mathematical functions, including MODULO and INTEGER, have been omitted entirely from the package.

Yet *Decision Graphics* does have its strengths, and these rest primarily in its ability to import data from other packages. Data is easily loaded from most spreadsheets and database management systems, and fixed-column format ASCII files may be imported as well. The important thing to remember is that *Decision Graphics* ba-

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Decision Graphics is best known for its data analysis graphics capabilities, but, as this screen indicates, it also offers a number of built-in procedures.

sically works best on clean, summarized data.

Analysis using *Decision Graphics* is for the most part limited to graphical interpretation of data. Univariate statistics, analysis of variance and covariance, and multivariate analysis procedures are not included in the package. The linear regression, time-series, and statistical functions that are included operate on single vectors of data. For example, a user could not perform a multiple regression using three explanatory variables.

Decision Graphics is one of the more thoughtfully designed programs.

The reporting of data is also limited primarily to graphs and charts. This is largely in keeping with the basic philosophy on the use of *Decision Graphics*: data is imported and graphs are exported. In addition to the hard copy output devices that are supported, the package can produce graphics files for exportation to *Lotus 1-2-3* (.PIC), *PC Paintbrush* (.PCX), *PageMaker* (.MSP), and *Samna Word* (.TIF).

Dialogs may be saved as user-written macros for easy reproduction. Users will find, however, that the most successful way to use the package is through the importing of clean, summarized data, since the database and mathematical capabilities of *Decision Graphics* are limited.

—Paul L. Marsh

Exec*U*Stat

*Exec*U*Stat*, $295 from Strategy Plus, is an introductory statistics and graphics package for the executive nonstatistician. Version 1.4 goes beyond the spreadsheet by offering a wide variety of elementary statistical procedures but is designed to be used in conjunction with a spreadsheet that manipulates the data.

*Exec*U*Stat* does a lot of nice statistical data functions. It has strong sections on descriptive methods, estimation and testing, regression, forecasting, and analysis of variance. It performs good basic plotting and lets you manipulate and annotate the graphs. It also has some other nice features, such as slide presentations and demo facilities, and it lets you use commands to jump around the menus.

*Exec*U*Stat* is a real memory hog that overwrites most TSR programs. Besides statistics and graphics, *Exec*U*Stat* includes an Executive Desk module with a scratch pad, telephone book, calculator, calendar, and an alarm clock. There is a module for financial calculations; namely, installment loans, net present value, internal rate of return, compound interest, and depreciation curves. These added features make *Exec*U*Stat* appealing to the business-minded executive.

*Exec*U*Stat* installs easily if you let the installation program make its own subdirectories, which it then calls the D: and the E: drives. You can specify any path with an alphabet of substitutions.

*Exec*U*Stat* imports five different file types: .DIF, SYLK (Multiplan), *dBASE*, *Lotus 1-2-3*, and ASCII. The file importing screens are a bit crude: there is no provision for changing path, and while filenames in the active data "drive" (directory) appear on the screen, you must retype the filename since you can't choose the file with a highlighted cursor.

The program couldn't import a badly conditioned test file, so the file had to be loaded into *1-2-3* and reorganized before *Exec*U*Stat* could read it. *Exec*U*Stat* has an editor for entering and changing data, but it's not as good as a spreadsheet. It can't delete rows across a file, only individual elements—and it can't read large files. These problems with elementary

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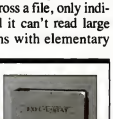
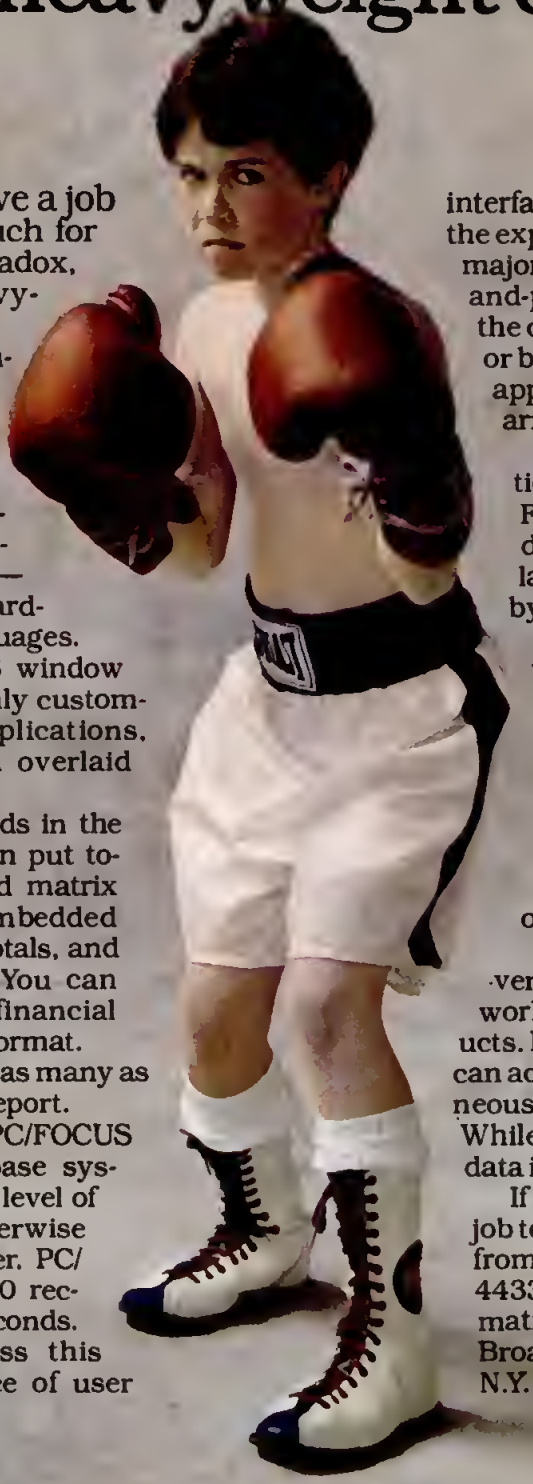


***Exec*U*Stat*,**
Version 1.4
Strategy Plus Inc.
5 Independence Way
Princeton, NJ 08540
(609) 924-9357
List Price: $295
Requires: 320K RAM; CGA, EGA or high-resolution graphics board; DOS 2.0 or later.
In Short: An integrated, menu-driven, statistics and graphics package written in C, *Exec*U*Stat* includes help screens that explain statistical concepts. Designed for the nonstatistician, it includes basic elementary statistical procedures and rudimentary data-management facilities, plus "executive desk" features. Not copy protected.
CIRCLE **691** ON READER SERVICE CARD

Can your lightweight database handle a heavyweight challenge?



When you have a job that's too much for dBASE or Paradox, turn to the real heavyweight. PC/FOCUS.

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Basic Statistical Analysis: Summary of Features

(Products listed in ascending price order)

GENERAL PROGRAM FACILITIES	Stat 1 $129.95	PC Statistix $169.00	StatPlan III $179.00	Exec*U*Stat $295.00	SP-Stat $295.00	ABstat $395.00	Microstat II $395.00
Data import and export							
Imports/exports .DIF files	O/O	O/O	O/O	●/●	●/●	O/O	●/●
Imports/exports Lotus 1-2-3 files	O/O	O/O	●/●	●/O	O/O	●/●	O/O
Imports/exports .DBF files	O/O	O/O	O/O	●/O	O/O	●/●	●/●
Macro facility	●	O	O	O	O	O	●
Batch facility	O	O	O	O	●	O	●
Math coprocessor support	●	●	●	●	●	O	●
EGA support	●	●	O	●	O	●	O
Maximum number of observations	Unlimited	32,000	54,000	3,000	300	8,000	Unlimited
Maximum number of data points	90	120	60,000	54	50	256	Unlimited
Maximum number of variables	Unlimited	120	100	54	150	256	Unlimited
Weighting allowed	O	●	O	O	●	●	●
DATA MANIPULATION							
Data verification	●	●	O	●	●	●	●
Spreadsheet-type editor	O	●	●	O	●	O	●
Data transformations	●	●	●	●	●	●	●
Error trapping	●	●	O	●	●	●	●
Conditional case selection	●	●	O	●	O	●	●
STATISTICAL ANALYSIS							
Descriptive statistics							
Medians	●	●	●	●	●	●	●
Frequency counts	●	●	O	●	●	●	●
Percentiles	●	●	O	O	●	●	●
Tables							
Chi-square	●	●	●	●	●	●	●
Cross-tabulations	●	●	●	●	●	●	●
t-tests (univariate)	●	●	●	●	●	●	●
Matched pairs	●	●	●	●	●	O	●

PC—Editor's Choice ●—Yes O—No

data manipulation can make working with *Exec*U*Stat* a very frustrating experience.

*Exec*U*Stat* has many tools for manipulating the data in well-conditioned files. However, these tools are somewhat cumbersome, and not all mathematical operations are possible. For instance, the missing-value function works on the whole file and not just a variable in one column, so it is essentially useless. To perform the sociological survey task, it was necessary to turn the response "3" into a missing value. But when the missing-value function was used, all 3s in the data were changed to blanks (missing); hence it was necessary to substitute −32,768, the internal code, for the missing value.

*Exec*U*Stat* needs better data manipulation. It sorely lacks a macro language for building the more-complicated procedures that are needed for going beyond the basics.

*Exec*U*Stat* uses menus with highlighted cursor bars and has a command line to be used in conjunction with the function keys. Unfortunately the use of the function keys was designed for the old XT-style keyboard and feels a bit uncomfortable on an Enhanced AT-style keyboard.

The help screens, which read like textbook definitions, display highlighted keywords that can be cross-referenced. The alphabetical index requires you to move the cursor through the alphabet—you can't type the letter from the keyboard.

*Exec*U*Stat* is an easy-to-use program for basic statistical procedures on well-organized data files. It makes nice graphs on the screen but does not have publication-quality output. *Exec*U*Stat* should not be

Decision Graphics $450.00	Cranch Statistical Package $495.00	NWA Statpak $495.00	PC Statistician with PC ANOVA $500.00	Minitab Statistical Software $695.00	SCA Statistical System $740.00	Statpro $895.00
●/○	●●	●●	●/○	○/○	●●	●●
●/○	○/○	○/○	○/○	●●	○/○	●●
○/○	●/○	○/○	○/○	○/○	○/○	●●
●	●	○	○	●	●	○
○	●	○	○	●	●	○
●	○	○	○	●	●	●
●	●	●	○	●	○	●
1,500	Unlimited	Unlimited	32,767	16,200	Unlimited	32,600
1,500	90	Unlimited	48	100	Unlimited	72
1,500	252	Unlimited	48	100	Unlimited	72
○	●	●	○	●	●	○
○	●	●	●	●	●	●
●	●	●	○	○	○	●
●	●	●	●	●	●	●
○	○	●	○	○	●	●
○	●	○	●	○	○	●
○	○	●	●	●	●	●
●	●	●	●	●	●	●
○	○	●	○	●	●	●
○	●	●	●	●	●	●
○	●	●	●	●	●	●
○	●	●	●	●	●	●

(continues)

considered as a high-end, complete statistics package, but it does give business users the opportunity to statistically analyze data.—**David Kushner**

Microstat II

Microstat II, Version 1.5, attempts to supply solid, no-frills statistical analysis for a lower price. The product, distributed by Ecosoft for $395, is a complete rewrite in C of the original BASIC Microstat that was released in 1978. The goal of *Microstat II* was to produce fast statistical results in an easy-to-use context. To accomplish this, the folks at Ecosoft ended up having to write their own C compiler. For the most part, Ecosoft has met its goals with *Microstat II*.

The major difficulty with *Microstat II* is its limited functionality. Ecosoft's goal was not to furnish a global statistics solution; indeed, the manual notes that "our experience showed us that (esoteric) additions increase significantly the cost of the package, slow down overall operation, and are used by very few people."

Installation of *Microstat II* is simple: the package comes on three disks, and an install program neatly loads them into the subdirectory of your choice.

Microstat II has a better-than-average user interface. It supports a mouse, a feature rarely found in statistical packages. Selection of menu items or scrolling through data is easily accomplished with mouse in hand.

The user interface is clean—a menu bar presents choices that can be selected by highlighting or typing the appropriate command letter. Data is presented clearly in spreadsheet format, with case numbers down the left side and field names across the top. The user can mouse or arrow off the edge to see more cases or more fields.

The first difficulty was encountered in loading data. *Microstat II* had no problem importing the file for quality control tasks, which was provided in comma-delimited ASCII format. Other files, such as the social science task data (which is not comma-delimited) and the market survey task data (which contained letters for Male and Female) proved more difficult.

Although the documentation claims that *Lotus 1-2-3* files can be imported, choosing the *1-2-3* option from the menu resulted in a message instructing the user to convert *1-2-3* files to .DIF format before attempting to import them. Because only numeric data is accepted, an external text

FACT FILE

***Microstat II*, Version 1.5**
Ecosoft Inc.
6413 N. College Ave.
Indianapolis,
IN 46220
(800) 952-0472
(317) 255-6476 (in Ind.)
List Price: $395
Requires: 512K RAM, DOS 2.1 or later.
In Short: A less expensive package, written in C, with fewer functions, limited graphics, and a nice user interface. *Microstat II* is a good choice for the part-time statistician. Not copy protected.

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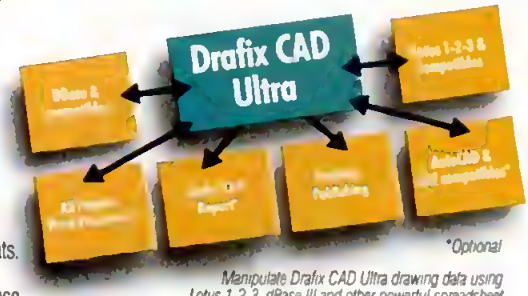

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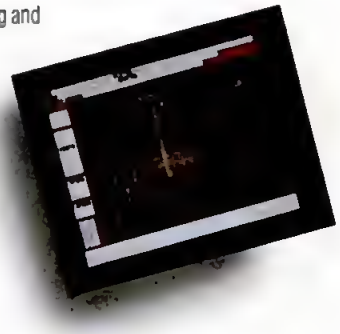

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Lotus 1-2-3

Basic Statistical Analysis: Summary of Features

(Products listed in ascending price order)

STATISTICAL ANALYSIS	Stat 1 $129.95	Statistix $169.00	StatPlan III $179.00	Exec*U*Stat $295.00	SP-Stat $295.00	ABstat $395.00	Microstat II $395.00
Correlations	●	●	●	●	●	●	●
Pearson's correlations	●	●	●	●	●	○	●
Spearman rank order	●	●	○	●	●	●	●
Analysis of variance							
ANOVA	●	●	●	●	●	●	●
Principal-component analysis	●	●	○	○	○	○	○
Contrast and planned comparison	○	○	○	○	○	○	○
Post hoc tests	○	○	○	○	○	○	○
Unbalanced design	●	○	○	○	○	○	○
Factor analysis	●	○	○	○	○	○	○
Regression							
Standard multiple (linear)	●	●	●	●	●	●	●
Stepwise	●	○	○	○	●	○	●
Nonparametric measures							
Fisher's exact test	○	●	○	●	●	●	○
Mann-Whitney U	●	●	○	○	●	●	●
Kolmogorov-Smirnov	○	●	○	○	●	●	●
Auto-correlation analysis	●	●	●	○	●	○	○
DATA REPORTING							
Default report styles	●	●	●	●	●	●	●
Customized report styles	○	○	○	○	●	●	●
GRAPHICS							
Bar and line graphs	○	●	●	●	●	●	●
Box and whisker plots	○	●	○	●	●	○	○
Probability plots	○	●	○	●	●	○	○
Graphs can be edited	●	○	○	●	●	○	○
Multiple fonts supported	○	○	○	○	○	○	○
OUTPUT							
Laser printers	○	●	○	○	○	○	○
Plotters	○	○	●	●	●	○	○
Film recorders	○	○	○	○	○	○	○
Color printers	○	○	○	○	●	○	○
HELP AND DOCUMENTATION							
On-line help	●	○	●	●	●	●	●
Tutorial	●	○	●	●	●	●	●
Toll-free telephone support	●	○	○	○	○	○	○

—Editor's Choice ●—Yes ○—No

Decision Graphics $450.00	Crunch Statistical Package $495.00	NWA Statpak $495.00	PC Statistician with PC ANOVA $500.00	Minitab Statistical Software $695.00	SCA Statistical System $740.00	Statpro $895.00
●	●	●	●	●	●	●
○	●	●	●	●	●	●
○	●	●	●	●	●	●
○	●	●	●	●	●	●
○	●	○	○	●	○	●
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○	○	○	○	●	●	○
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(ends)

processor was required to convert "M" to 1 and "F" to 2 before the market data could be used. Alpha characters show up as "Missing data", although numeric data can be displayed in an alpha format through the use of aliases. In every case,

Microstat II has a better-than-average user interface.

except for the quality control engineering task, the data had to be manipulated in some way before importing it. This effort was not always successful.

While data can be translated (one column can be the computed result of one or more columns), the functions are limited. Since *Microstat II* does not include the MODULO function required by the biology task, a complex formula composed of INTEGER functions was used to replace the missing MODULO. However, the calculated results were incorrect, apparently because of a malfunction in the parentheses nesting hierarchy.

Another shortcoming of *Microstat II* is its lack of graphics. The package does offer a nice scatterplot in one or two variables and includes the linear regression line endpoints in the graph. The package will also generate frequency distribution bar graphs that are simple to create and pleasing to the eye. Some data-smoothing algorithms produce clever graphs that include the raw and smoothed data on the same chart.

Microstat II is a pleasant package to use (frustrations with data importation aside), but short on function. The authors claim to have the ability to handle large numbers (such as 1.0E300!), to be fast and to require less RAM than their competitors. In general, these claims proved to be true. These benefits, and the lower price, may

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Extended VGA Modes			
360x480 256 colors	Yes	Yes	Yes
640x350 256 colors	Yes	With User Upgrade	With User Upgrade
640x480 256 colors	Yes	With User Upgrade	With User Upgrade
800x600 16 colors*	Yes	Yes	Yes
800x600 256 colors*	Yes	With User Upgrade	With User Upgrade
1024x768 16 colors*	Yes	With User Upgrade	No
3 - 132 column 16 color modes	Yes	Yes	Yes
100% Register and BIOS Compatible with VGA, MCGA, EGA, CGA, MDA and Hercules	Yes	Yes	Yes
Auto Mode Switch, Auto 8/16 Bus Sense and Auto Monitor Select	Yes	Yes	No
Suggested Retail Price	$599	$499	$399

** Supports these standards on both interlaced (IBM 8514 and compatibles) and non-interlaced (NEC Multisync XL and compatibles) monitors.*

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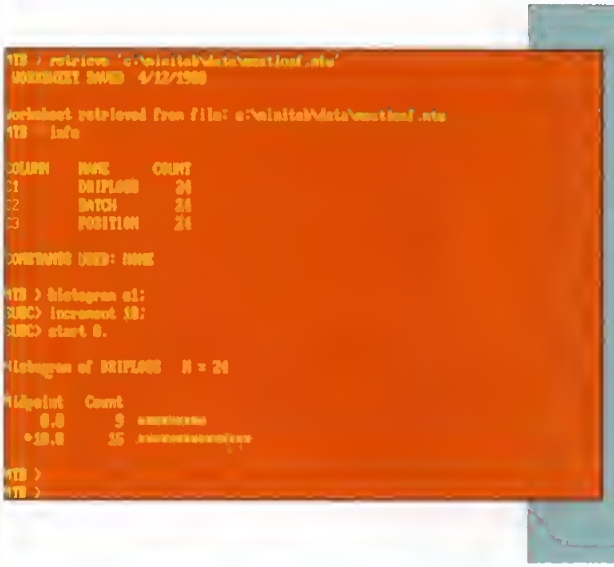
offset the missing capabilities, particularly if your demands for complex statistical manipulation are low.
—**Martin L. Ramsay**

Minitab Statistical Software

There's a lot to be said for consistency and simplicity; *Minitab Statistical Software*, Version 6.1, comes with lots of both. For $695, Minitab gives you consistency, simplicity, plus over 180 commands and a macro language and backs it all up with an established customer base and strong customer technical support to give you a powerful general-purpose statistics program. The product is positioned for non-Ph.D. statisticians who want to get "up and running" quickly.

Minitab is *Minitab*. It runs the same way on many computer systems, in all cases using a simple, straightforward command structure to control operations. With all present versions *Minitab* users can move between hardware systems at will, confident that they can always get their statistics done because they already know how *Minitab* works on any computer on which it runs. But don't come to this party if you insist on using a mouse with pull-down menus.



Minitab Statistical Software's command-line interface requires attention and exactness, but responds quickly and gives precise control. Once a worksheet has been retrieved, the info command lists the columns of data, column names, and number of observations in each. A histogram of the data is displayed at the bottom of the screen.

Minitab is entirely command driven. It has a full range of commands but a consistent one-command-at-a-time mode of operation, though you can specify one or more optional subcommands. By staying away from graphics interfaces, the publisher is better able to keep the program the same in different hardware environments.

Minitab handles alphabetic data, although the range of commands for alphabetic data is much more limited than with numeric data. A Convert command lets you switch data between alphabetic and numeric formats. Data is always stored in columns on the worksheet, and you do have to be somewhat prudent about the number of columns and rows that you use. *Minitab* requires some cells for scratch space so, with only 16,000 or so cells to use, you have to think about the size of a matrix of columns and rows when you're dealing with large file sizes with lots of columns.

The only time we ran into a problem with our testing was when trying to import a file with 1,534 records and 21 variables. When you do run out of space, the program gives an informative message and then suggests that you delete unnecessary columns in your present worksheet to create more space. The most important news here is that the program doesn't crash if you try to fit in too much data. Once the data is in, there's not much you can't do with it.

Although *Minitab*'s features are not exhaustive, the range of available procedures will let you build most anything you need, given the program's macro ability. The macro creation process consists simply of recording keystrokes. Macros can be saved for later use and edited. Because macros can be nested and can call other macros, you can automate extremely complicated data manipulation and analysis scenarios.

All *Minitab* reports use default output styles. You can specify that output goes to the printer or file, as well as the screen. Normal graphs are the usual low-density, low-appeal ASCII graphics, but *Minitab* also has a high-resolution graphics command set that lets you issue individual commands to build fancier graphs. *Minitab* doesn't claim the ability to produce presentation-quality graphics, but it can go beyond the primitive, asterisk-style graphs used by many stat packages.

Minitab comes with gobs of documentation, including a quick reference card, user manual, basic primer, comprehensive program handbook, and a comprehensive reference guide. That's a lot of information!

Minitab's only limitations are its command line interface and the general,

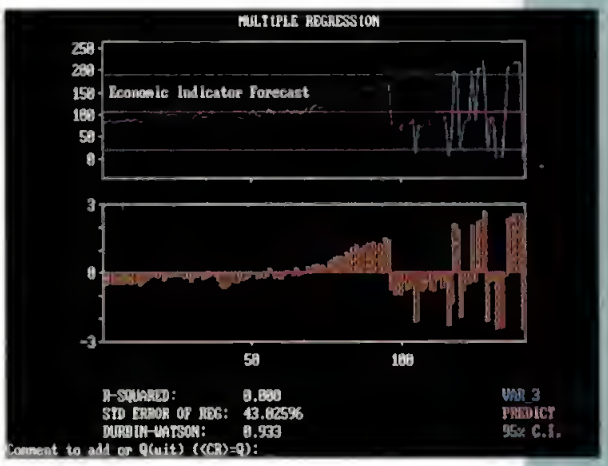
PC MAGAZINE FACT FILE

***Minitab Statistical Software*, Version 6.1**
Minitab Inc.
3081 Enterprise Dr.
State College, PA 16801
(814) 238-3280
List Price: $695
Requires: 512K RAM, hard disk recommended, DOS 2.0 or later. Math coprocessor recommended.
In Short: An elegant, completely command-driven program with a full range of capabilities and functions plus an easy-to-use macro system. *Minitab* is available on a wide variety of computers and operating systems. Written in FORTRAN, it is intended for non-Ph.D. users who need a tool that can perform a wide range of statistical manipulations. Not copy protected.

CIRCLE 689 ON READER SERVICE CARD

though wide, selection of functions. Each of these cases is intentional: running programs by command only is usually much quicker than working through menus, and *Minitab*'s general nature fits the vendor's goal. Menu-driven programs seldom give you the power that *Minitab* affords users with its macro capabilities. While you have to know what to tell the program to do and how to tell it, the possibilities are broad indeed.

A new release of the program, *Minitab* 7.0, due in the second quarter of 1989, will extend the program's operations significantly. Unless you have very specific needs better addressed by other programs (a case in point being automatic forecasting) *Minitab* is highly recommended as a general-purpose statistical analysis program.—**Bruce Brown**



These graphs by *NWA Statpak* show the results of our financial forecasting task. The upper graph shows a linear regression of the data; the lower graph shows the regression residuals.

NWA Statpak

NWA Statpak, $495 from Northwest Analytical, is a conglomeration of compiled BASIC programs that do a variety of statistical functions. Rather than a system, *NWA Statpak*, Version 4.1, is more like a library of programs loosely tied together by an overlying menu structure and a shared file format.

Statpak comes on nine disks that contain a total of 85 files. Installation is simple: you copy your choice of files to the subdirectory of your choice. Although the software could easily be run on a dual floppy disk machine, the complete program set occupies over 3MB on a hard disk machine. A network version is available for $950.

Statpak will import ASCII or .DIF files. Since the sample data for the quality control engineering, biological research, marketing research survey, and econometric modeling tasks were delimited by either commas or spaces, which *Statpak* sees as delineators between fields, loading the data was relatively easy. The social science research data was not delimited, but was in fixed-length fields. *Statpak* has a facility for defining the position and length of fixed field files so that they can be imported. The facility is rather tedious to use, but it works. Sample data that contains missing fields or that has alpha data with imbedded blanks is troublesome: missing fields cause the data to shift one column to the left, while an embedded blank causes the field to be interpreted as two separate pieces of data.

Once loaded to a *Statpak* format file, the data can be browsed and edited with several tools, the best of which is SPEDIT, a spreadsheet-like display of the data in rows and columns. The other tools filter unwanted data, calculate one column based on other columns, add ranking information to the data, and so on. Each of the other tools is tiresome to use; with the exception of SPEDIT, tools use a line-oriented user interface. Most likely this is because of the language the program is written in: BASIC is notorious for accepting input one line at a time.

Statpak makes some very nice graphs. Several of the programs have the ability to output data to a graphics file, as well as to the screen, the printer, or to disk. The graphics file can then be sent to a plotter, printer, or high-resolution monitor by one of several programs. The graphics file can also be edited by the EDPLOT tool. The graphs produced from the quality control engineering and marketing research survey data were particularly pleasing.

The sample marketing research survey task data had some bogus information, such as 86 bottles of cola consumed per week and sex=X. To clean this up, a second file, to screen out unwanted records, had to be created. Using the SELECT tool, this seemed an easy enough task. The problem came in an attempt to use Boolean logic. SELECT has the ability to identify valid data ranges and to link selection ranges together with AND or OR. But since there is no ability to group the Boolean operators, this function proved less than useful. Another problem is *Statpak*'s paucity of built-in functions: only four arithmetic, seven trigonometric, and five additonal procedures are supported. The MODULO function required by the bio-

FACT FILE

***NWA Statpak*, Version 4.1**
Northwest Analytical Inc.
520 NW Davis
Portland, OR 97209
(503) 224-7727
List Price: $495; BASIC source code, $75; Network version, $950.
Requires: 512K RAM, DOS 2.0 or later. Certain routines require CGA, EGA, or Hercules compatibility.
In Short: *NWA Statpak* is a library of various statistical analysis routines written in BASIC. It has nice graphics but a tedious user interface. Not copy protected.
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SHAREWARE AND FREE STATISTICAL SOFTWARE

How do the hundreds of statistical analysis programs available as shareware and freeware stack up? We take a look at some of the best.

In addition to the hundreds of commercially available statistical analysis packages, there are hundreds more in the form of shareware and free statistical packages. Unlike the commercial packages, most of the shareware and free packages are not general-purpose, although some are. While some real gems exist, many of the shareware and free packages are worth less than what they cost, so be careful.

One common problem of shareware and free programs is a lack of technical support. Not all of these programs neglect support, but it's a factor to consider when comparing shareware and free software with commercial software.

In the general-purpose category, the best-known is *Epistat* (Epistat Services, 2011 Cap Rock Circle, Richardson, TX 75080-3417; (214) 680-1376). While *Epistat*, Version 3.3, has some unusual features, such as an implementation of Bayes's theorem, it also has a number of significant problems. In particular, neither the ANOVA nor the regression estimates are to be trusted. The author also sells a commercial version of the product, *True Epistat*, which is more complete.

As with *Epistat*, other general-purpose shareware packages are demonstration, or smaller, versions of commercial software. While *Epistat* preceded its commercial version, the commercial version typically precedes the shareware version.

The best of the shareware or free general-purpose packages is *Mystat*, from the makers of *Systat* (Systat Inc., 1800 Sherman Ave., Evanston, IL 60201; (312) 864-5670). Single copies of *Mystat* are available free, with printed documentation, to those who write to Systat. Multiple copies, as many as you want, are available for $5 per copy. The vendor does not allow distribution through bulletin boards for several reasons, including worry about unauthorized changes to the program.

One of the best things about *Mystat* is the excellent choice of specialized programs that use *Mystat* data files. These are supplied very inexpensively by Gerard Dallal (53 Beltran St., Malden, MA 02148). Dallal writes very usable software that fills the gaps left by even the large, expensive general-purpose packages. His programs include randomization tests, power and sample-size analysis, comparisons of dependent correlation coefficients, and Bartholomew's tests for increasing proportions or increasing means.

Other good general-purpose packages include *Kwikstat* (TexaSoft, P.O. Box 1169, Cedar Hill, TX 75104; (214) 291-2115, $39), *I STAT* 5.3 (Gary Perlman, Department of Computer and Information Science, Ohio State University, Columbus, OH 43210; (614) 292-5813, $25), and *SPPC* (Walmyr Publishing Co., P.O. Box 3554, Leon Station, Tallahassee, FL 32315). Each of these has certain desirable features.

KwikStat, Version 1.3, reads *dBASE* files directly and can actually be run from within *dBASE*. *I STAT* 5.3, modeled on Unix, comes as a disaggregated set of files that you integrate on the command line via pipes. It has some unusual abilities, such as signal processing. Much of *SPPC*, Version 4.0, is modeled after Jacob and Patricia Cohen's regression text (*Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*). However, the quality of the results and the data set size can be a problem with each of these programs.

There is a slew of special-purpose programs. Some of these are aimed at particular disciplines. For example: *Ecstat* 1.2 (Robert Dohner, Fletcher School, Tufts University, Medford, MA 02155, $25) is intended for economists; *MVSP* 1.3 (Warren L. Kovach, Department of Biology, Indiana University, Bloomington, IN 47405, $25) considers the needs of biologists and geologists; *Survpak-PC* 3.0 (Biostatistics and Information Systems, Room 119, The Johns Hopkins Oncology Center, 600 N. Wolfe St., Baltimore, MD 21205, $50) is a survival-analysis program aimed at medical researchers.

Another type of specialized program consists of a general version of a specific type of analysis. Although numerous general-regression packages abound, at least one is solely for polynomial regression.

Version numbers are particularly important for shareware and free software, since distribution channels for this software are often quite variable. Something else to consider: while I am a registered user of a number of the above-mentioned packages, virtually none of them inform me of updates.

While in some other software categories shareware is equal to or better than many of the corresponding commercial packages, statistical analysis shareware and free software are generally not as good as commercial software. The packages mentioned above and very specialized packages for which there may not even be commercial equivalents are prime exceptions.—**Richard Goldstein**

logical task was not supported, and a substituted equation using INTEGER functions ended up with severe rounding errors that made it impossible to use.

Statpak's documentation is a curious blend of examples and terse information. When looking for help with the Boolean logic problem, the manual indicated only that "if another selection is to be performed, its definition will begin with the relation (AND or OR) to the previous criteria." There was no further discussion, but the technical support people at NWA were helpful in suggesting ways to circumvent the problem. One strong point of the documentation was the appendix, which lists every formula used by *Statpak*. If you want to know how *Statpak* calculates the chi-square Bartlett statistic, you can find out quickly.

I can see a user browsing through the *Statpak* manual and checking off the programs that would be useful. If *Statpak*'s goal is to offer a library of functions, then it succeeds. The user interface's line-by-line entry seems cumbersome and archaic in these days of full-screen editors and point-and-shoot techniques. (By the way, if programming is your bent, Northwest Analytical will sell you the BASIC source code for an additional $75.) *Statpak* is starkly functional with attractive graphs but no whistles or bells.—**Martin L. Ramsay**

PC Statistician
PC ANOVA

PC Statistician, $300 from Human Systems Dynamics, is a general-purpose statistical package whose primary audience is social scientists. *PC Statistician* was spawned from an Apple II program called *StatsPlus* that first appeared in 1981. *PC ANOVA*, $200, is a newer program that attempts to strengthen the older package by adding the capability to perform such things as repeated measures, split-plot, and Latin squares. *PC Statistician*, Version 1.1, and *PC ANOVA*, Version 1.0, are menu driven, with no provision for macro or stored-program processing.

The package is easy to install, and new users will be up and running within minutes. However, caution must be exercised by hard disk users since both *PC Statistician* and *PC ANOVA* use a file named AUTOEXEC.BAT to begin execution. Installing the software blindly in the root directory of the hard disk could result in the loss of your system file with that same name. The program lacks additional user configurability to accommodate equipment such as EGA monitors and 132-column printers.

Most necessary database management tasks can be performed by using *PC Statistician* and *PC ANOVA* together. Besides being able to enter, add, and correct data observations and variables, users can perform DOS directory-level tasks such as deleting, renaming, and printing files. A wide range of data transformations are available. Additions certainly could be made in this area, though, since some basic mathematical and logical functions such as MODULO, INTEGER, and NOT are omitted. Both .DIF and blank-delimited ASCII files may be imported. However, data screening could be improved with the addition of a full-screen spreadsheet-style editor and a good alphanumeric tabulation procedure.

PC Statistician covers some basic statistical analyses. Frequency distributions, descriptive statistics, computation of group means, cross-tabulation, nonparametric statistics, t-tests, analysis of variance, correlation, and regression can all be performed with the package. *PC ANOVA* strengthens the package by adding several new procedures including analysis of covariance, repeated measures, split-plot, post hoc testing and Latin square testing.

Vital additions could be incorporated into both pieces of software. For example, neither program includes a sorting procedure. This particular omission is further aggravated by the inability to exit temporarily to DOS; thus, the user cannot even use system utilities or other programs to overcome the shortcomings.

Output generated by *PC Statistician* and *PC ANOVA* is clear and readable. Graphics can be performed by many of the analytical procedures, greatly enhancing the interpretation of results. Improvement could be made in this area by allowing users to control both the number of decimal places displayed and the ability to capture output for additional analysis.

Together, *PC Statistician* and *PC ANOVA* furnish basic statistics adequate for many users. However, serious researchers will find that the inability to bypass the menu-driven interface, plus omissions in passing data and results between procedures, greatly diminish the utility of these packages.—**Paul L. Marsh**

FACT FILE

Human Systems Dynamics
9010 Reseda Blvd., #222
Northridge, CA
91324-3971
(800) 451-3030
(818) 993-8536 (in Calif.)

***PC ANOVA*, Version 1.0**
List Price: $200
Requires: 256K RAM, CGA, DOS 2.0 or later.
***PC Statistician*, Version 1.1**
List Price: $300
Requires: 256K RAM, CGA, DOS 2.0 or later.
In Short: *PC ANOVA* is a newer program that attempts to strengthen the overall computation capabilities of the Human Systems Dynamics software line. *PC Statistician* is a general-purpose statistical package that is the second generation of an Apple II program. Both packages are written in compiled BASIC. Not copy protected.

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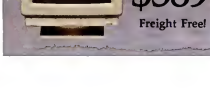

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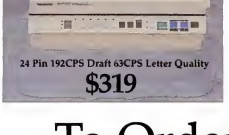

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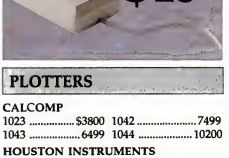

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product worth mentioning (but not reviewed in this article) is *PC-QPI*, a quality and productivity improvement package.

SCA products run on a variety of platforms from PCs to mainframes. As such, their products are not able to take advantage of some PC capabilities, like support for high-resolution graphics or a mouse, for example. Instead, the software is command driven with no menus or other prompts. The "graphics" are text-based. Despite these limitations, the command structure is easy to learn and reasonably intuitive.

One of the striking differences between the *SCA Statistical System* and other packages is the manner in which it handles files and fields. While other packages treat a case, or row of fields, as a single entity, *SCA* treats each field or variable independently. When a file is imported you do not create a matrix of rows (cases) by columns (variables). Rather, you create one variable for each imported field, with a subscript that indicates the case index number. There are certain advantages to this concept: you can manipulate small pieces of data or create ad hoc variables that do not have to match the structure of other data. It also means SCA is adept at handling matrix variables.

This method of variable handling also creates some interesting problems. For example, in cleaning up the marketing research survey task data, I wanted to omit any case in which the number of bottles consumed per week was greater than 12. To do this, I used the Omit command on the *Consumpt* variable. But eliminating bad items from *Consumpt* would not delete the associated *Age* or *Sex* variables unless I specifically told *SCA* to treat them with the results of the *Consumpt* cleanup. Another small problem was that I could only clean one variable at a time. Because the *Sex* variables were recorded as characters, they could not be cleaned by using the Omit function.

SCA did a fine job of creating the charts required by the quality control task, especially the Pareto chart, but the graphs were not particularly attractive without high-resolution graphics. *SCA* did very well with the biological research task data: the complex math transformations were no problem, and the correlations were easy to generate. Likewise, the charts generated for the market survey task contained the right information, even though they weren't boardroom quality.

Serious problems were encountered when trying to import the social-science research survey task data. The database for this task is extensive: 23 variables for each of 1,534 cases. *SCA* couldn't handle the volume: it choked three-fourths of the way into the data import. Increasing the size of *SCA* to its maximum 35K work area, as suggested in the troubleshooting sheets, still didn't leave enough room.

SCA, with the $145 *PC-UTS* program, performed very well in the forecasting task. *SCA* includes useful utilities such as a running percent change calculator with a variable lag period, seasonal smoothing algorithms, and even a function that takes Easter into account. The ARIMA functions are rich and flexible.

There was a problem with importing the data, which came in two pieces: an 80-column piece and a second, smaller piece. *SCA* had no problems gluing the two pieces together, but it couldn't import more than 72 columns. This is apparently an undocumented limitation, probably stemming from *SCA*'s FORTRAN origins. I circumvented the problem by using a text editor to split the 80 columns into two narrower pieces and then by gluing those together with the third piece.

SCA is a powerful package, particularly in time-series analysis. It is rather fastidious about its data importation, but this would not be a problem if you collected your data with its limitations in mind. The documentation is done reasonably well. Because of its mainframe origins, it doesn't take full advantage of a PC's capabilities, but you can always move up to a mini or mainframe version if you outgrow your PC.—**Martin L. Ramsay**

PC MAGAZINE FACT FILE

SCA Statistical System
Scientific Computing Associates
Lincoln Center, #106
4513 Lincoln Ave.
Lisle, IL 60532
(312) 960-1698
List Price: *PC-GSA+* module, $595; *PC-UTS*, $145.
Requires: 512K RAM (640K recommended), hard disk, DOS 2.1 or later. Math coprocessor recommended.
In Short: Especially good at time-series analysis and forecasting. *PC-UTS* with *PC-GSA+* has a command-driven user interface but no graphics. Written in FORTRAN, *SCA Statistical System* runs on mainframe as well as PC platforms. Copy protected.

CIRCLE **686** ON READER SERVICE CARD

SP-Stat

SP-Stat isn't ready yet; it needs a bit of work before it's done. Unfortunately, the program has been available in its present, unfinished form, Version 1.02, since 1984. In its present form the $295 *SP-Stat* from Softext Publishing is too limited for any serious business statistics work and too difficult for any but the most patient user.

The publisher's concept—simple and easy-to-use statistics—is a laudable goal that isn't quite reached. Softext says that *SP-Stat* is designed to perform standard statistics for relatively low-level end-user applications; it's not intended for heavy statistical requirements. However, be-

PC MAGAZINE FACT FILE

***SP-Stat*,**
Version 1.02
Softext Publishing Corp.
17 E. 45th St.
New York, NY 10017
(212) 986-5985
List Price: $295
Requires: 256K RAM, DOS 2.0 or later.
In Short: Written in Pascal, *SP-Stat* is a limited statistics program that can produce three types of charts. Because of its small observation capacities, functional limitations, and awkward operation, it is not recommended. If you will be using statistics a great deal you eventually may want to move on to a more capable program. Not copy protected.

CIRCLE **685** ON READER SERVICE CARD

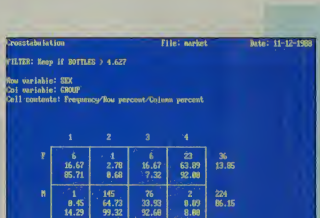
A Day in Five Lives: Marketing Research Survey

Task 2

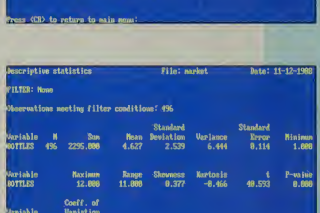
Posing as the product manager for a cola company rolling out a new diet soft drink, the reviewer analyzed the results of a 6-month marketing research survey to develop a profile of the target consumer. Reviewers received a data set with three pieces of information for 500 subjects: age group, cola consumption, and sex.

To analyze the data, we

- performed a validity test on the 500 cases, disregarding problematic data;
- determined descriptive statistics for consumption (including frequencies);
- performed a crosstab on consumption and age;
- created a table from the crosstab;
- determined which age group drinks the most cola and broke that group down by sex.



Crunch Statistical Package creates a cross-tabulation table using *sex* as the row variable and *group* as the column variable.



Crunch summarizes the descriptive statistics calculated for the marketing research survey task.

cause of its limitations on the number of observations—300 at most—we were not able to complete or even start most of our test tasks. You can't sort, and you can't display numeric data with more than two decimal points. The program is also awkward to use, imposing strict adherence to a rigid system that isn't adequately documented.

SP-Stat is menu driven; you make selections by moving your cursor to menu items. One oddity is the use of the Tab key to abort or back out of a procedure. Another procedure, this one undocumented but mentioned quickly by tech support, is the use of the Esc key at the end of the last record when entering data or when specifying files; if you press Enter instead the program starts a new, blank data or file record, often with unhappy results.

You have to work with two types of *SP-Stat* files, master files and data files. To perform any analysis at all, you have to set up a master file that simply keeps track of data files. A data file can have only one observation and label per record. For example, sales for the year could have dollar amounts as data shown against the names of months as labels. And numeric data is limited to two decimal places, a significant drawback for many applications.

SP-Stat supports delimited ASCII, *dBASE II*, .DIF, and SYLK file formats. This assortment of file types reflects the program's vintage: these were the hot file formats in 1984. You can usually convert data in other programs to one of these formats first and then bring that preconverted file into *SP-Stat* for the program's own

conversion, but obviously that extra step is cumbersome.

The program is also very strict about filename extensions. For example, imported delimited files must have the extension .DLM. This is not a big deal, but it is an unnecessary aggravation; the program's target audience shouldn't have to spend time fixing files so that they are palatable to the program—at least not with something as simple as filename extensions.

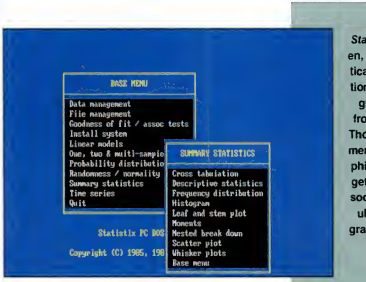
Once you import the data, you can use a screen editor to modify or correct it. This editor is more than a line editor but not a full-text editor. Basically you are limited to moving around one screen at a time, using *WordStar*-like commands.

The loose-leaf documentation is printed on glossy paper. While the manual claims you won't need the documentation because the program is self-documenting, that's not the case. Unfortunately, you won't find much help in the documentation, either. The explanations are often unclear and the outline format is inconsistent, mixing topics and subtopics with abandon. There is, however, an index and a reasonably helpful appendix with all formulas for statistical procedures listed.

Customer support is available only during business hours. At other times, however, you can leave a message on a machine. This is not exactly the most reassuring type of support, but at least the phone is answered.

SP-Stat's publishers say that they are working on a new version. I'd wait to look at the new one rather than buy the presently limited, awkward program.

—Bruce Brown



Statistix is menu driven, with all of its statistical manipulation options categorized into groups accessible from the main menu. Though the program's menuing system is sophisticated, once you get to the screens associated with a particular menu item, the graphical interface becomes Spartan.

Statistix

The focus of *Statistix*, $169 from NH Analytical Software, is on utility, not aesthetics. An inexpensive, no-nonsense package, Version 2.0 gives you the tools to automate over 75 statistical analyses of data commonly used in scientific research. Delivered in a plain plastic wrapper with a GBC-bound manual, *Statistix*'s menu-driven interface is certainly far from elegant and its output is merely functional, but it does what it promises to do.

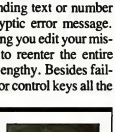
Designed for "the researcher in general," *Statistix* is a tool kit intended for use by scientists in academia, industry, and government. Its large selection of linear models—including numerous regressions and analyses of variance and covariance—make it especially well-suited for the biological and medical communities. It produces a wealth of plain-looking calculations and standardized graphs that succinctly present data analyses.

The package demands a knowledge of statistics: as long as you are familiar enough with the subject to know what sort of analysis you require, you'll be fine. For example, you need to know that you can always add or subtract a constant to a set of numbers without changing the standard deviation. This is important because, to maintain numerical accuracy, the package displays only four significant digits (sometimes five in the analysis of variance and regression-related calculations), requiring most uniformly large and small data sets to be transformed in order to yield meaningful information.

Data can be entered into *Statistix* using a *Lotus 1-2-3*–like editor or read in as ASCII text. Reading previously captured data into the package can be a frustrating experience, however, even though the program can accept FORTRAN–like format statements. Unless all the data is in a form acceptable to the package (it will not accept alphabetic data, and it often won't tolerate missing data, for example), it will not be read into the package. Although *Statistix* has its own editor, it can be used only on data that's been successfully read into the package, so if your data is not accepted, you must fix it using another editor. The package does at least present an error message indicating why it won't accept the offending data.

In general, *Statistix* is a rather intolerant program. If you manage to breach its syntax—which isn't difficult—it will beep and point to the offending text or number with a sometimes cryptic error message. Then, rather than letting you edit your mistake, it'll force you to reenter the entire string, which can be lengthy. Besides failing to support all cursor control keys all the

FACT FILE



***Statistix*, Version 2.0**
NH Analytical Software
1958 Eldridge Ave.
Roseville, MN 55113
(612) 631-2852
List Price: $169
Requires: 256K RAM, DOS 2.0 or later.
In Short: A no-nonsense package for knowledgeable users written in Pascal, *Statistix* is especially well-suited for linear modeling.
Not copy protected.

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time, the package lacks an on-screen guide to tell you which keys it will accept, though there certainly is room for such guidance on the bottom of its largely blank screens. The package's creators promise their next release will address these problems, but even in its present form, once you learn how to deal with it, it's very easy to whip through *Statistix*'s menu and data screens.

Besides the statistical manipulation capabilities mentioned in the features table, *Statistix* can do all subset regressions, an alternative to the step-wise regressions used for finding best-fit models. It can also perform Poisson regressions, as well as a variety of probability functions that save users from having to look up p-values in tables. Its transformation capabilities include 35 built-in functions.

The software's laser-printed manual is sometimes difficult to navigate and in places appears haphazardly updated, but it tells you what you need to know, usually supplying helpful examples. (Interestingly, though the manual's creators assumed its users to be statistically literate, they assumed no computer literacy whatsoever; the installation section painstakingly explains how to copy diskettes using DOS's COPY command.) Technical support was excellent for this reviewer.

—Kellyn Betts

Stat 1

Thank goodness there's room for diverse products in the world of statistical software. Sugar Mill Software's *Stat 1*, Version 3.05, is aimed at users with relatively modest needs who aren't expert statisticians. *Stat 1* users can take advantage of a consistent menu structure and more types of on-line help than you can shake an abacus at. At $129.95, *Stat 1* is a good choice for its intended audience: managers and non-Ph.D. professionals who need to perform basic statistical manipulations on numeric data. To top it off, toll-free customer support is available forever for free, although the company's Hawaiian location somewhat limits support line usage.

Stat 1 is heaviest on descriptive statistics: it's easy to select a whole range of calculations. The program is lighter on time-series analysis and doesn't perform automatic forecasting. While you can force the program to do other types of procedures by using equations to do data transformations, it defeats the program's stated purpose: *Stat 1* is not intended for the kind of user who can or even wants to write equations.

In the current release, *Stat 1* imports and exports only ASCII files. The program includes a DOS editor to clean up or alter files, and you can exit temporarily to DOS to work with files or use other programs to perform other manipulations *Stat 1* can't do. Since *Stat 1* doesn't sort data, you can exit to DOS to use another program to sort the data file on a given key. When you come back to *Stat 1* all the previous settings and selections are still in effect.

One of the biggest drawbacks of the program for our testing was its inability to handle nonnumeric data. The program's editor proved useful both in removing commas from files using them as field delimiters and changing alphabetic code keys to numeric keys.

All data reports use default report styles that are functionally sufficient and no more. Since you cannot edit reports, and since graphing capabilities are limited (you can get a histogram or a scatterplot, but that's about it), you won't find this program useful if you need publication- or presentation-quality output.

Data reports can be sent to any ASCII printer or saved as DOS files. When saving screens to a file you can either have one screen per file or append the contents of the current screen to an existing file. This convenient feature is valuable for documenting your work. There's also a screen buffer that saves several previous screens so that you can scroll back to see what went on before, another nice touch.

Stat 1 uses a series of hierarchal menus for all functions. Keyboard function keys are implemented as well, but certainly in the beginning, and for casual users, the menus are the way to go. There is one drawback to the menus in *Stat 1*: You have to move down through other options to highlight your choice before hitting the Enter key; there's no first initial or key-letter operation.

FACT FILE

***Stat 1*, Version 3.05**
Sugar Mill Software Corp.
1180 Kika Pl.
Kailua, HI 96734
(800) 367-8047 ext. 261
(808) 261-7536 (in Hawaii)
List Price: $129.95
Requires: 256K RAM, DOS 2.0 or later.
In Short: *Stat 1* is an entirely menu-driven program with a sensible program flow. Although it lacks some high-end statistical functions, is light on graphics output choices, cannot use anything other than numeric data, and cannot sort data, *Stat 1* is still appealing because it's so easy to use and works hard to help you analyze your data. Written in APL, the program has a four-level help system including a decision-tree problem solver and a glossary. *Stat 1* is intended and most appropriate for managers and non-Ph.D. users. Not copy protected.

CIRCLE **644** ON READER SERVICE CARD

The manual, which is reasonably readable and includes some light, Hawaiian-inspired examples, is organized by program function and includes screen shots, tables, and helpful hints and cautions.

Stat 1 has an impressive series of help systems. Yes, that's *series*. Besides on-line, context-sensitive help there are three other help systems. One is an expert system of sorts that walks you through a decision tree to determine the statistical manipulation appropriate for your needs. Another is an on-line glossary, and the final option is a reference tree to find sources of further information about specific procedures or tests in the body of scholarly knowledge. The context-sensitive help system was written by Sugar Mill Software, but the others are used under license from the University of Michigan's Institute for Social Research. This variety and depth of on-line help is terrific.

Stat 1 only needs 256K RAM and will even work on a two-floppy system. It installs easily and is even easier to configure to your operational preferences. It's easy to change system settings, for example, to get automatic printouts of all statistical runs. You can alter the defaults so that they take place whenever you start the program

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or just during the present session.

There are a few things Sugar Mill Software could do to make *Stat 1* easier to use, such as including single-key menu choice selections and perhaps mouse support, but otherwise this program is most noteworthy for the steps the publishers have taken to make it approachable and relatively easy to use.—**Bruce Brown**

StatPlan III

StatPlan III, $179 from The Futures Group, is not designed to compete head-on with professional statisticians' packages. Instead, its aim is to supply easy-to-use, menu-driven routines for the person who does statistical analysis but doesn't need the power of a programming language. According to The Futures Group, *StatPlan*

StatPlan III is

not easy to use.

You can get lost

four levels deep

in its menus.

III, Version 1.40, is strongest in the areas of time-series analysis and multiple regression.

Certainly no one will mistake this program for a powerhouse. But *StatPlan* users don't have to trouble themselves with specifying a lot of procedural details. Not only is everything menu driven, but the menus themselves keep distracting options to a minimum. No need to specify the "bin" values for a histogram, for example; the program chooses for you. No need to worry about setting graph colors; the program is limited to high-resolution CGA

FACT FILE

***StatPlan III*, Version 1.40**
The Futures Group
76 Eastern Blvd.
Glastonbury, CT
06033
(203) 633-3501
List Price: $179; 8087 version, $189.
Requires: 256K RAM, DOS 2.0 or later.
In Short: Written in Pascal, *StatPlan III* is a flawed, inflexible program aimed at the non-professional user. Not copy protected.
CIRCLE **663** ON READER SERVICE CARD

output, so it's all black and white. No need to fuss over the details of presentation-quality output; *StatPlan* supports only Epson-compatible dot matrix printers and does almost all its printing by calling the PrintScreen interrupt.

No need to get involved with data recoding or logic-based data transformations; the program won't do these things. It also won't accept text values of any kind. And there's no chance of getting confused by extra-large or small numbers. A note obscurely tucked away in Appendix A of the manual advises that *StatPlan* may not give reliable results with numbers greater than 10,000 or less than 0.1. Indeed, when *StatPlan* was tested with a series of numbers that differed at the fourth decimal place, it behaved as though all values were identical.

But easy to use it is not. For starters, many branches of the menu tree go four or more levels deep, and not one menu is named on-screen. It's a simple matter to get lost.

StatPlan's user interface is reminiscent of 1982-vintage shareware. Data files are saved by default to A:\ , and you can't override the default by including drive and path in a filespec. Trying to save a file to C:*StatPlan*\test when the default is A:\ will get you a file on drive A: called CSTATP. Menu options allow you to change the default drive and directory, but if you specify a nonexistent directory, *StatPlan* can trash your data.

The Quit command does not warn you if you have unsaved work in memory; it just presents a Lotus-style "are you sure" prompt. And the file-translation routines (which are limited to *1-2-3*, *Symphony*, and ASCII) don't warn if you are about to overwrite an existing file.

The program has no option to turn off the color signal for the benefit of CGA users with composite monitors. But you can call the vendor to request a "special version."

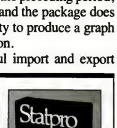
With problems like these, does it really matter that *StatPlan* does multiple linear and polynomial regression, exponential smoothing, auto-correlation analysis, curve fitting, and trend and cycle analysis? To paraphrase Monty Python, this is not a program for using; this is a program for lying down and avoiding.—**Craig Stinson**

Statpro

For the professional statistician performing complex analysis of variance and regression, Penton Software's $895 *Statpro*, Version 2.0, is a powerful tool. For a business, social science, or marketing analyst, however, *Statpro* is less useful. Its recoding functions, particularly its method for recoding time-series data as the percentage change from the preceding period, are overly complex, and the package does not have the capability to produce a graph from a cross-tabulation.

Statpro's powerful import and export

FACT FILE



***Statpro*, Version 2.0**
Penton Software Inc.
257 Park Ave. South
New York, NY
10010
(800) 221-3414
List Price: $895
Requires: 256K RAM, DOS 2.0 or later.
In Short: *Statpro* is a menu-driven database, statistical analysis and graphics program that allows easy import of data from a variety of formats for custom cross-tabulations and complex statistical analysis. Written in Pascal, it lacks the ability to create graphs from cross-tabs and has a restrictive limit of 72 variables in a workfile. Copy protected.
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feature accepts data in ASCII, *dBASE*, *1-2-3*, *Symphony*, .DIF, or SYLK file formats, using either fixed format or values separated by a space or any other character. Erroneous data is automatically changed to the missing-value character, with its location recorded on-screen as it is read in. Data must be numeric and can be checked to ensure that it falls in an acceptable range of values.

The program is divided into modules covering database management, statistics, graphics, and workfile creation/utilities. The database manager module allows listing, editing, inserting, joining, sorting, and transforming of the data. The statistics module allows the computation of an exhaustive set of statistics. Statistical outputs are used as inputs for the graphics module, which produces scatterplots, regression and residual curvefit graphs, variance plots, moving averages, cost efficiency and normality plots, and a variety of multivariate plots including vector graphs, dendrograms, circular star plots, and Andrew's Fourier plots.

Statpro features incredible depth in the areas of regression, analysis of variance, and nonparametric statistics. For more-routine analysis, however, the program is difficult to use, with everyday tasks such as bar charts and frequency tables referred to in the software as "frequency of data values histograms" and "one-dimensional cross-tabs." Furthermore, the program suffers from an inability to chart the percent of observations in each bar, charting only the frequency instead.

Statpro contains a powerful formatting feature for producing custom cross-tabs. It uses format libraries to define the value of each variable to be included in each row or column of the cross-tab. A simple editing screen lets you produce format libraries, but since format libraries are stored as plain ASCII text, they can be created with most any word processor.

Statpro produces frequencies of a variable by running a one-dimensional cross-tab. This is somewhat confusing: a separate frequencies procedure would make it easier to perform this routine task. Similarly, the computation of the median of a distribution is overly difficult. *Statpro* hides the median under the menu choice "Non-Parametric Descriptive (Range) Statistics". While the median is such a statistic, this category is difficult for the nonexpert statistician to decipher. The median (and other statistics in this category) can be computed only for a variable with less than 1,000 observations. When I tried to run a data set with 1,534 observations through this procedure, the computer froze after the first 1,000 without displaying an error message.

The most crippling limit of *Statpro* is that a workfile can contain no more than 72 variables (called fields). Many surveys and other statistical research databases contain more than this number of variables and would have to be broken up to be analyzed with *Statpro*. The limit of 32,600 observations is less troubling for statistical analysis on a PC.

Statpro's data recoding function is overly complex. It lacks a simple if-then transformation routine, requiring programming to perform simple recoding. However, the software can automatically transform all data in a series by means of a mathematical formula, transform Cartesian to polar coordinates, or convert a wide range of units of measurement (for instance, centimeters to inches).

Statpro is particularly powerful in its analysis of regression and variance.

Graphs produced in *Statpro* contain very little labeling information, leaving it to the user to type in. In graph editing mode, you can enter text in one of several fonts. A word of caution: once text is entered on a graph, deleting it leaves an inverse rectangle and entering and exiting graph edit mode can cause pixels to invert randomly.

Statpro is easy to install, well documented, and functions with a variety of monitors. Although it's copy protected, the program can be installed twice; to prevent copying off a hard disk, it stores some installation data in files hidden from DOS. A simple command installs graphics drivers for CGA color or black and white, EGA, or Hercules monochrome monitors.—**Frederick Barber**

PC MAGAZINE EDITOR'S CHOICE

- *Minitab Statistical Software*
- *Statistix*

Basic stat packages are a student's delight and a godsend to business people who need to do routine, simple statistical procedures; manageable is what they are. Their documentation doesn't double as a set of barbells, and you don't have to go buy a dedicated machine to run one of these packages. But, as is always the case when you cut things down to size, something you need ends up missing.

We chose Minitab Statistical Software *as Editor's Choice because it makes some wise choices in terms of what to include.* Minitab *offers consistency and simplicity, but its excellent command language and macro facilities make it possible to push the envelope. Because it runs on so many different machines it's an excellent choice for the "work wherever I can find a CPU" student.*

Statistix *is another modest-sized package worth investigating. It automates 75 of the most commonly used statistical analyses in a flexible menu-driven system. With its good data-handling techniques,* Statistix *achieves a fair degree of sophistication—without sacrificing speed.*

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ECONOMETRIC MODELING

Econometrics is the measurement of economic theory through the use of mathematical and statistical methods. Econometric methods assist in the evaluation, comparison, and forecasting of the myriad theoretical models an economist may use. While statistical inference implies only the testing of a well-defined hypothesis, econometrics goes one step further by helping to formulate the model and develop a testable hypothesis. All in all, econometrics provides the bridge between data and the economic theory used to interpret the data.

The ideal econometric package should allow easy model creation, estimation, and forecasting. (Dedicated forecasting packages are reviewed in the next section.) Data manipulation capabilities are very important, especially since the data economists use is derived from real-world events, not the laboratory. Model building and solving techniques—particularly matrix algebra—are a necessary part of a good package. A wide range of estimation techniques is desirable to allow the widest range of model comparison possible. Finally, forecasting techniques should be easy to use and easy to repeat.

ESP

Mikros's *ESP* (*Econometrics Software Package*), Version 2.31, is designed to do high-level econometric time-series analysis. Its strength lies in its sturdiness, but you'll have to contend with a somewhat old-fashioned interface to discover its true worth.

The tested configuration of *ESP* (model estimation with simulation for forecasting and planning, $1,295) installs in a straightforward enough manner. The package includes a fairly complete tutorial to acquaint you with importing and exporting data, accessing databases and sample data, managing the internal databanks, and generating and transforming data. The tutorial does not cover all the advanced functions of *ESP*, but there is an adequate reference manual that considers them. While the information you'll need to take advantage of *ESP*'s functions is all there, you'll have to actually learn *about* econometrics somewhere else.

For the most part, *ESP* is command driven. The user interface shows its mainframe ancestry in its "interactive" teletype terminal: you get to type in commands at the prompt; when you hit the bottom of one work slate, another clean slate appears. This can be annoying when data is split between two screens, but the program somewhat makes up for this by letting you recall the last ten user entries.

FACT FILE

***ESP*, Version 2.31**
Mikros Inc.
76 Bedford Street
Lexington, MA
02173
(617) 861-8852
List Price: $795 (estimation only); $1,295 with simulation.
Requires: 384K RAM (for estimation only), 512K RAM (for estimation and simulation); Hercules, CGA, EGA, or VGA; DOS 2.1 or later. Supports math coprocessor.
In Short: *ESP* is a comprehensive econometric package with mainframe roots. This program is best for analyzing historical data, mathematical simulation, and forecasting. It includes good data manipulation and strong programming facilities. Not copy protected.

CIRCLE 650 ON READER SERVICE CARD

ESP imports and exports numerical data in time-series format from ASCII, .DIF, SYLK, .WKS, and .WK1 files. *ESP* can also create random data and generate new data from existing data by using mathematical equations. Its full-screen editor is adequate for inputting or changing individual data entries, but if you want to create fancy reports, you'll have to export your data to a word processor.

ESP's regression analysis allows the use of ordinary least squares and other iterative techniques; it is perhaps one of the program's strongest features. Other examples of the program's soundness are its ability to perform Box-Jenkins analysis, create specialized estimators, and carry out auto-correlation analysis. *ESP* also makes it easy to manipulate data using its macro language, batch techniques, procedures, and run files. The only unfortunate note here is that you cannot edit the run files from within *ESP*.

Even with its old-fashioned interface, *ESP* is still a sturdy package.

ESP creates CGA-quality plots that can be scrolled across the screen while keeping the vertical axis fixed. When it comes to printing them, though, *ESP* lags behind similar packages. It does not offer PostScript support and does not have facilities for printing publication-quality charts. The only way to print the graphs is to use the PrSc key.

While *ESP*'s general statistics section includes the usual mean, standard deviation, variance, and matrix funtions such as correlation, covariance, and principal components, the product is obviously not

geared to the general statistician. It does not do frequency analysis and histograms; it does not make simple statistical plots such as bar charts and pie charts; and it can't do Pareto or control charts.

If you're not looking for a flashy, statistical-presentation show horse but are interested in a robust, econometric forecasting workhorse, *ESP* is a good choice.
—**David Kushner**

Lisrel Prelis

Lisrel, from Scientific Software, analyzes multivariate data according to a paradigm combining the features of both econometrics and psychometrics into a single mathematical model. *Prelis*, as the name implies, is Scientific Software's program for a first pass through the data before using *Lisrel*. (*Lisrel* and *Prelis* are sold together for $460.)

The first version of *Lisrel* (1970) was a linear structural-equation model for latent variables; later versions were expanded to include more general covariance structures. *Lisrel* is highly constrained by the class of models that it must fit to the data. While these models are in fact quite general, a certain amount of sophistication (and work) is required to translate from the language of *Lisrel*-type models into more common statistical parlance.

Lisrel 7 is a new version of a tried-and-true mainframe program that has been widely used for many years to analyze multivariate data, primarily in the social sciences. In adapting *Lisrel* to the PC, however, its authors did not exploit any of the PC's distinctive features that could have made these packages easier to use. Most notably, *Lisrel* must always be run in batch mode. A list of (nonintuitive) commands must be put into a file using an editor, and the file is then run through the program. For those accustomed to more interactive computer environments, this cumbersome throwback to the days of mainframes is certainly not welcome. The output, while complete, comes in an unmodifiable ASCII format.

Prelis is required for the analysis of missing, ordinal, censored, or non-normal data. It performs a number of the preprocessing tasks that are also available in *Lisrel*, specifically the calculation of multiple regressions between variables. For this reason, Scientific Software suggests that *Prelis* may be useful on its own, but its limited repertoire of statistical capabilities makes it a poor choice compared with more general statistical packages.

While both packages perform well within their advertised capabilities, they find a number of tasks virtually impossible to accomplish. Both programs can do the difficult jobs of producing correlation matrices between a number of variables, computed according to a number of techniques, but neither package is very good at providing a first look at raw data. There are no spreadsheet facilities, and aside from a few rudimentary graphs of some specific parameters in the *Lisrel* model, neither package has any graphical capabilities.

If you want to perform a function even as simple as producing a histogram of the data, or a probability distribution of continuous variables, these packages offer no help at all. Even more serious, very few handles in the package allow for the manipulation of the raw data. Aside from the simple logarithmic and power law transformations of the data you'll find in *Prelis*, the programs offer no mathematical capabilities.

Lisrel performs one very circumscribed task quite well. Given the problem of modeling multivariate data—a problem that most often arises in the social sciences—*Lisrel* performs several sorts of difficult analyses that are not available in other packages. (*Lisrel*'s earned a low score on the social science task because it could not perform a few of the assigned jobs, such as graphics, but this should not imply that it isn't suited for analyzing data from the social sciences.)

Even if your research problems require the specific tools that *Lisrel* offers, the package will not suffice for a complete analysis of the data. At the very least, a decent graphics package would be necessary to present the results. For anyone who has used older versions of this program, a new PC version would be a worthwhile investment. For the majority of statistical applications, however, *Prelis* and *Lisrel* cannot be recommended.—**Clay Reid**

FACT FILE

***Lisrel*, Version 7**
***Prelis*, Version 1**
Scientific Software Inc.
1369 Neitzel Rd.
Mooresville, IN 46158-9312
(317) 831-6336
List Price: $460 for both, plus $7 shipping within the U.S., $30 outside the U.S.
Requires: 640K RAM, DOS 2.0 or later. Supports math coprocessor.
In Short: *Lisrel* combines both econometrics and psychometrics in a single mathematical model to analyze multivariate data. *Lisrel* shows its mainframe roots in many ways, not the least of which is its requirement to run in batch mode. *Prelis* performs a number of preprocessing tasks not available in *Lisrel* and is necessary for analyzing missing, ordinal, censored, or non-normal data. Not copy protected.

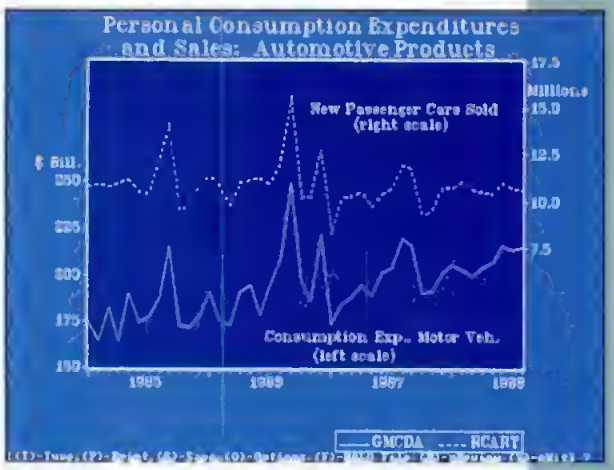
CIRCLE 649 ON READER SERVICE CARD

Micro TSP

Micro TSP, $595 from Quantitative Micro Software, is a time-series processor designed for use as a cost-effective alternative to mainframe econometric programs. Besides offering basic regression analysis tools, the package includes modules for two-stage least squares, nonlinear least squares, polynomial distributed lags, ARIMA, vector auto-regression, and complete system estimation and modeling capabilities.

Micro TSP, Version 6.0, is shipped with seven diskettes. The installation procedure is program driven, allowing only three installs onto floppy disks or a hard disk drive from the original install diskette. If you plan to install *Micro TSP* on a hard disk, set aside at least 1MB.

Micro TSP is a command-driven program with some interactive capabilities. Most commands have been assigned to function keys and can be accessed by toggling through key definitions listed on the



Micro TSP graphs the results of ARIMA analyses for personal consumption expenditures and automotive sales on the same graph.

bottom of your screen. The user may also enter the command directly and will be prompted for additional input as needed.

The program's internal data management is quite sophisticated and includes a full-screen data editor. Data can be easily transformed within *Micro TSP*, minimizing the need for external spreadsheet or text editor manipulation. Besides ASCII import, *Micro TSP* can import data in .WK1, .WKS, and .DIF file formats.

Micro TSP's documentation is outstanding. Because it contains many helpful examples and educational tutorials, someone new to econometrics will find the manual an invaluable training guide. For the more advanced user, the documentation serves as a well-designed reference guide. Also accompanying *Micro TSP* is a diskette containing sample data and a fully automated tutorial that leads the user through many functions and applications offered by the program. However, making some of this information available on-line in the form of context-sensitive help would be a welcome enhancement to the program and would save the user from having to search for the manual whenever a problem arose.

Although *Micro TSP* was designed primarily as a tool for economic analysis, it could complete portions of the scripts designed for the general-purpose packages. For example, it was able to report the basic descriptive statistics required in the quality control engineering task.

The program did an exceptional job of performing all the operations required by the forecasting task. It retrieved the task data in .WK1 format with no problem. The output from the estimation procedure was very clear and concise, with more information available for output only a keystroke away.

Micro TSP's graphics are quite sophisticated (for an econometrics package). Time series and residual plots are supported, as are scatter plots. Both EGA and VGA modes are supported, allowing the program to present very attractive output. Text can be added anywhere in the graph—in one of four sizes—by simply positioning the cursor and typing. With the help of the pen plotter programs included with *Micro TSP*, the user can plot graphs on HP and HP-compatible plotters.

Micro TSP specializes in the techniques associated with the analysis of economic time-series. It does an excellent job of fulfilling the needs of its niche; I would highly recommend it to any person in need of an easy-to-use econometric package. However, general statisticians may find future versions of *Micro TSP* worth acquiring, since the publishers promise to offer enhanced cross-sectional functions such as cross-tabulations, conditional selection, chi-square tests, and histograms.

—Anthony J. Tilke

FACT FILE

***Micro TSP*,**
Version 6.0
Quantitative Micro Software
4521 Campus Dr., #336
Irvine, CA 92715
(714) 856-3368
List Price: $595
Requires: 384K RAM, DOS 2.1 or later. Supports math coprocessor.
In Short: *Micro TSP* contains strong regression and forecasting tools, including modules for two-stage least squares, nonlinear least squares, polynomial distributed lags, and vector auto-regression. With *Micro TSP* you can develop a statistical relation from data and then use the relation to forecast future values of the data. Copy protected.

CIRCLE **648** ON READER SERVICE CARD

OTIS

Odin Research's $995 *OTIS* not only lets the user perform econometric analysis, but it also incorporates database features for maintaining your time-series data.

Version 1.2 is trivial to install (a batch file on the distribution diskette copies all the necessary program and help files onto a hard disk) and easy to use. Unfortunately, it is copy protected, requiring a key disk for it to load.

OTIS uses a command-line interface, and time-series variables must contain a character in their names to tell the system their type. For example, *$name* refers to an equation, *#name* refers to a parameter (scalar), and *!name* refers to a list of text strings (called a letter series). By having a letter series contain the names of other objects, those objects can be treated as a group. This makes handling multiple lists of data much easier; it also makes it possible to turn *OTIS* into an effective database system for time-series data.

The command language uses batch files in a way that is very similar to DOS's, including the way it passes arguments. To control the program's Loop command, which the manual (wrongly) says cannot be nested, you need use only the Skip and Break commands. While the language has

Econometric Modeling: Summary of Features

(Products listed in ascending price order)

Although the packages reviewed in this section have different market niches, they share common features. All have a batch facility and a macro language, and each one supports a math coprocessor. As for managing data, they all handle data transformations; when it comes to reporting data, they all supply default report styles.

Although these packages don't focus on descriptive statistics, they can calculate means, standard deviations, Max/Min, and R-squared values. They perform linear and standard multiple regressions. Model solving and simulation, first-order serial correlations, and correlation coefficients are also in their statistical repertoire.

	Lisrel and Prelis	Micro TSP	Soritec	ESP	PowerStation	OTIS
GENERAL PROGRAM FACILITIES	$460	$595	$595	$795	$895 and up	$995
Data import and export						
Imports/exports DIF files	○	●	●	●	○	○
Imports/exports Lotus 1-2-3 files	○	●	○	●	●	○
Imports/exports DBF files	○	○	○	○	○	○
Expert language	○	●	●	○	●	○
Expanded/extended memory support	○	●	○	○	●	○
EGA support	○	●	●	●	●	○
Maximum number of observations	Unlimited	32,000	14,000	1,000	800	Unlimited
Maximum number of data points per file	Unlimited	32,000	1,000	1,000	500	Unlimited
Maximum number of variables	100	32,000	3,000	17,000	10,000	Unlimited
Weighting allowed	●	○	○	●	●	○
DATA MANIPULATION						
Data verification	●	●	○	●	●	○
Spreadsheet-type editor	○	●	○	●	●	○
Error trapping	○	●	●	●	●	○
Conditional case selection	●	●	●	○	●	○
Equations displayed	○	●	●	●	●	●
Equations saved and restored	○	●	●	●	●	●
STATISTICAL ANALYSIS						
Descriptive statistics						
Medians	○	○	●	○	●	○
Frequency counts	●	○	●	○	○	○
Percentiles	○	○	●	●	○	○
Skewness and kurtosis	●	○	●	○	○	○
Box-Pierce Q statistic	○	●	●	○	●	○
Goodness-of-fit statistics						
Chi-square tests	●	○	●	●	○	○
Cross-tabulations	○	○	●	○	●	○
t-tests (univariate)	●	●	●	●	●	○
F tests	○	●	●	●	●	●
von Neumann ratios	○	○	●	○	○	●
Likelihood ratios	●	●	●	○	●	○
Matched pairs	●	○	●	○	○	○
Pearson's correlations	●	○	○	○	●	●
Analysis of variance						
ANOVA (analysis of variance)	●	○	●	●	○	○
ANCOVA (analysis of covariance)	●	○	○	●	○	○
Principal-component analysis	○	○	●	●	○	○

—Editor's Choice ● —Yes ○ —No

	Lisrel and Prelis	Micro TSP	Soritec	ESP	PowerStation	OTIS
STATISTICAL ANALYSIS	$460	$595	$595	$795	$895 and up	$995
Multivariate analysis						
MANOVA (multivariate analysis of variance)	●	○	●	○	○	○
MANCOVA (multivariate analysis of covariance)	●	○	○	○	○	○
Discriminant analysis	○	○	●	○	○	○
Factor analysis	●	○	○	●	○	○
Log-linear models	●	●	●	●	●	○
Regression						
Nonlinear	○	●	●	●	●	○
Probit	○	●	●	○	●	○
Stepwise	○	●	○	○	●	○
Least squares	●	●	●	●	●	●
Restricted and generalized	●	●	●	●	●	○
Two-stage	●	●	●	●	●	○
Three-stage and nonlinear	○	●	●	●	○	○
Vector auto-regression	○	●	○	○	○	○
Time-series analysis						
Auto-correlation analysis	○	●	●	●	●	●
Cross-correlation analysis	○	●	●	●	○	●
Data smoothing	●	●	●	●	●	●
Brown's	○	○	●	○	○	○
Quadratic	●	●	●	○	○	○
Holt-Winters exponential	○	●	●	○	○	○
Forecasting						
Automatic model selection	○	○	○	●	●	○
Forecast from equations	○	●	●	●	●	●
Forecast versus actual figures displayed	○	●	●	●	●	●
Trend curve	○	●	●	●	●	●
Seasonal decomposition	○	●	●	●	●	●
ARMA, ARIMA modeling	●	●	●	●	○	○
Polynomial distributed lags	○	●	●	●	●	○
Intervention detection	●	●	● (with programming)	○	○	○
Transfer functions	●	●	●	○	○	○
Nonparametric measures	○	○	●	●	○	○
System equation estimation						
Full-information maximum likelihood	●	●	●	○	●	○
Limited-information maximum likelihood	●	○	● (with programming)	○	○	○
Zellner's seemingly unrelated regression	●	●	●	●	○	○
DATA REPORTING						
Customized report styles	○	●	●	○	●	○
Publication-quality reports	○	●	●	○	●	○
GRAPHICS						
Bar and line graphs	○	○	●	○	●	●
Error bars	○	●	○	●	●	○
Log and semi-log charts	○	●	●	○	●	○
Scatterplots	○	●	●	●	○	●
Graphs can be edited	○	●	○	○	●	○
Multiple fonts supported	○	●	○	○	○	○
OUTPUT						
Laser printers	○	●	○	○	●	○
Plotters	○	●	○	○	●	○
HELP AND DOCUMENTATION						
On-line help	○	○	○	●	●	●
Tutorial	○	●	●	●	●	●

"Beware the March Ides!"

They told Julius C
And he'd have known what was coming
If he'd had a PC.

□ **3½" format available from us. Specify when ordering.**
◙ **package includes both 5¼" and 3½" disks.**
■ **3½" format available from manufacturer by request. Call us for details.**
CP—copy-protected, **NCP**—not copy-protected

SOFTWARE

We only carry the latest versions of products. Version numbers in our ads are current at press time.

Aldus ... NCP
□PageMaker 3.0 ..... call
Alpha Software ... NCP
□Advanced Keyworks 1.0 ..... 175.
◙AlpheWorks 1.0 *(integrated package)* .... 115.
□ALPHA/three 1.0 *(dB3 file compatible)* ... 219.
American Small Business Computers
□Design CAD 3.1 *(NCP)* ..... 159.
□Design CAD 3D 1.1 *(NCP)* ..... 159.
Application Techniques ... NCP
◙Pizazz Plus 1.2 ..... 75.
Ashton-Tate ... NCP
□dBASE IV 1.0 ..... call
□RapidFile 1.2 ..... 219.
◙MultiMate Advantage II 1.0 ..... 299.
□Master Graphics 1.0 ..... 299.
□Framework III 1.0 ..... 459.
Autodesk
□Autosketch Standard 1.04 ..... 55.
Barron's ... CP
■SAT *(Test preparation program)* ..... 35.
Best Programs ... NCP
□Label Master 3.1 *(mailing label program)* .. 29.
□Report Manager 5.0 ..... 199.
□Fixed Asset System 5.0 ..... 359.
Bible Research ... NCP
□The Word 4.2 *(King James version)* ..... 159.
□The Word 4.2 *(New International version)* . 159.
Bloc Publishing ... NCP
□FormTool 2.01 ..... 55.
□Form Filler 1.5 ..... 89.
□Personal Lawyer 2.0 ..... 39.
□PopDrop 3.1 *(manages your ram resident programs without rebooting)* ..... 39.
Borland International ... NCP
■Turbo C Professional Pack *(includes assembler)* ..... 169.
■Turbo Pascal Professional Pack *(includes assembler)* ..... 169.
◙Paradox OS/2 1.0 ..... 479.
■Prolog 2.0 ..... 99.
■Turbo C 2.0 ..... 99.
■Turbo Pascal 5.0 ..... 99.

PC Connection Software Special
through March 31, 1989

Chipsoft ... NCP
■Turbo Tax Personal/1040

Turbo Tax, the award winning tax preparation software from Chipsoft, has been making filing your tax return fast and easy for the past five years. And this year's version is no exception. Included are over 40 forms, schedules, and worksheets, as well as an optional Visual 1040 mode.

- Pop-up calculator, notepad, and on-line IRS instructions
- Visual 1040 mode option allows you to fill out and view any form or schedule on screen
- New Auto-Interview to help you find the forms you need, and Data Examiner to help pinpoint omissions
- Prints IRS approved dot matrix 1040
- State tax packages also available

Turbo Tax Personal/1040 (for 1988 taxes). $43.
State Packages Personal/1040 6.0 . .each 32.
(3½" available from mfr. upon request)

■Turbo Assembler & Debugger 1.0 ..... $99.
■Reflax 1.1 ..... 99.
■Sidekick Plus 1.0 ..... 135.
■Sprint 1.0 ..... 135.
■Quattro 1.0 w/SQZ!Plus 1.0 ..... 165.
◙Paradox 2.0 ..... call
■Turbo Editor Toolbox 4.0 ..... 69.
■Turbo Database Toolbox 4.0 ..... 69.
■Turbo Basic Editor Toolbox 1.0 ..... 69.
■Turbo Basic Database Toolbox 1.0 ..... 69.
■Superkey 1.1 ..... 69.
Bourbaki ... NCP
□1DIR+ 3.0 ..... 49.
Bridgeway Publishing ... NCP
□FastTrax 3.9 ..... 35.
Broderbund ... CP
□Print Shop 2.41 *(incl. Graphics Library 1)* 39.
□Mamory Mate 3.01R *(NCP)* ..... 45.
Chipsoft ... NCP
■TurboTax Personal/1040 6.0 ..... special
■State Packages Personal/1040 6.0 .... special
■TurboTax Proseries/1040 5.0 ..... 229.
Chronos Software ... NCP
■Who•What•When *(people, projects, time)* 119.
Computer Associates ... NCP
◙SuperCalc 5 1.0 ..... 319.
Core International ... NCP
□Corefast 2.0 ..... 95.

Crosstalk Communications ... NCP
□Remote² 1.01 ..... $95.
□Crosstalk XVI 3.7 ..... 95.
□Crosstalk MK 4 1.1 ..... 124.
Dac Software ... NCP
□Dac-Easy Payroll 3.0 ..... 59.
□Dac-Eesy Light 1.0 ..... 45.
□Dac-Easy Accounting 3.0 ..... 59.
Delrina Technology ... NCP
◙Par:FORM 1.0 ..... 159.
Digital Research ... NCP
□Gem Desktop 3.0 ..... 35.
□Gem Draw Plus 2.01 ..... 189.
5th Generation ... NCP
◙Fastback Plus 2.01 ..... 109.
Fox Software ... NCP
■Foxbase Plus 2.1 *(single user)* ..... 209.
■Foxbase Plus 386 2.1 ..... 319.
Funk Software ... NCP
□Sideways 3.21 *(creates wide printouts)* .... 42.
◙Worksheet Utilities 1.0 *(1-2-3 utilities)* ..... 59.
◙Inword 1.0 ..... 59.
□Allways 1.0 ..... 89.
◙Noteworthy 1.0 ..... 49.
General Information ... NCP
■Hot Line Two 2.0 ..... 49.
Generic Software ... NCP
□Generic CADD Level 1 ..... 35.
◙Generic CADD Level 2 ..... 55.
◙Generic CADD Level 3 *(now includes Dot Plot)* ..... 135.
◙3D Solids 2.2 ..... 189.
◙Estimator ..... 159.
□Basic Home Design 3.0 ..... 35.
□CADD Starter Kit *(contains Level 2, Home Design, Workbook tutorial, & sample disk)* . 89.
Harvard Associates ... NCP
■PC Logo 3.0 ..... 59.
Hayes ... NCP
◙Smartcom II 3.0 ..... 89.
Hilgraeve Software ... NCP
□HyperACCESS 3.31 ..... 89.
Individual Software ... NCP
◙Typing Instructor Encore 2.13 ..... 26.
□Professor DOS 2.51 *(with Smartguide)* .... 33.
■101 Macros for 1-2-3, WordPerfect, and others ..... .each 42.
Intuit ... NCP
◙Quicken 2.0 ..... 35.
Javelin ... NCP
■Javelin Plus 2.02 ..... 249.
Lotus ... NCP
◙Agenda 1.0 ..... 289.
□1-2-3 2.01 *(upgrade free to version 3.0)* ... call
□Freelance Plus 3.0 ..... call
□Symphony 2.0 ..... call
◙Manuscript 2.0 359

For IBM Personal Computers exclusively.

PC CONNECTION®

If he'd had good projections

They couldn't cut him down
For before the cock crowed
He'd have been out of town.

MECA ... NCP
- ◙ Checkwrite Plus 1.0 ... $29.
- ◘ Financial Calculator 1.0 ... 33.
- □ Meneging Your Money 5.0 ... 119.
- ◘ Andrew Tobies' Tax Cut 1040 ... 49.

Meridien Technology ... NCP
- □ CarbonCopy Plus 5.0 ... 115.

Micro Logic ... NCP
- □ Tornedo 1.8 ... 55.

Microlytics ... NCP
- □ GOfer 1.0 *(text retrieval system)* ... 45.
- □ Wordfinder 4.0 *(electronic thesaurus)* ... special

MicroPro ... NCP
- □ WordStar Professional Release 5 ... 259.
- □ WordStar 2000 Plus Rel. 3 *(Personal Ed.)* 259.

Microrim ... NCP
- ◙ R:BASE for DOS (version 2.1) ... 449.
- ◙ R:Base for OS/2 ... 599.

Microsoft ... NCP
- □ Learning DOS 2.0 *(for eny DOS version)* ... 35.
- □ Windows 286 2.1 ... 69.
- ◙ Windows 286 2.1 w/Mouse ... 145.
- □ Works 1.05 ... 99.
- ◙ Windows 386 2.1 ... 129.
- ◙ Word 5.0 ... cell
- ◙ Chart 3.0 ... 259.
- ◙ Excel 2.1 *(requires 80286/80386 CPU)* ... 239.

CD-ROM
- Bookshelf 1.0 w/Amdek Laser Drive ... 799.
- Programmers Library 1.0 ... 269.

LANGUAGES
- □ Quick BASIC 4.5 ... 69.
- □ Quick C 2.0 ... 69.
- ◘ Macro Assembler 5.1 ... 99.
- ◘ Basic Compiler 6.0 ... 199.
- ◘ Pascal 4.0 ... 199.
- ◘ Fortan 4.1 ... 289.
- ◘ C Compiler 5.1 ... 299.
- ◘ Cobol 3.0 ... 599.

Monogram ... NCP
- □ Dollars and Sense 3.1 ... 105.

Nantucket Software ... NCP
- ◙ Clipper *(Summer '87, dB3 Plus compiler)* 429.

New England Software ... NCP
- ◙ Graph-in-the-Box Release 2 ... 75.
- □ GB-Stat 1.0 ... 159.
- ◙ GB Analytic 1.0 ... 105.

Nolo Press ... NCP
- □ WillMaker 3.0 ... 35.

North Edge Software ... NCP
- □ Timeslips III 3.3 ... 119.

Owl International ... NCP
- □ Guide 2.0 ... 143.

Paperback Software ... NCP
- □ VP-Info 1.4 ... 65.
- □ VP-Plenner Plus 2.0 ... 145.
- □ VP-Expert 2.0 ... 145.

PC Connection Software Special

through Merch 31, 1989

Software Publishing ... NCP
- ◙ Harvard Graphics 2.12
- ◙ Harvard Graphics Accessories Master Pack

Show off your own custom reports, overhead transparencies, slides, or any on-screen presentation with Software Publishing's Harvard Graphics. Some of its capabilities include

- Creating your own charts from scratch or choosing one that's pre-formatted
- Reading 1-2-3 graphs and data or any ASCII file
- Incorporating symbols, drawings, etc., from the Harvard Graphics Accessories Master Pack (including Business Symbols, Designer Gallery, Map Maker, Quickchart, and Screenshow)

Harvard Graphics 2.12 (3½" included) $289.
Harvard Graphics Accessories Master Pack (3½" included) ... 289.

Paul Mece ... NCP
- □ H/Test-H/Format 2.0 *(hard-disk tools)* ... $49.
- □ Mace Utilities 5.0 *(DOS utilities)* ... 55.
- □ Mace Gold 1.0 ... 79.
- □ Grasp 3.1 ... 79.
- □ Nvelope 1.02 ... 29.

PC Support Group ... NCP
- □ Lightning 4.82 ... 39.
- ◙ Lucid 3-D 1.22 ... 75.

Parsonics ... NCP
- □ SmertNotes 2.0 ... 49.
- □ SeeMORE 1.02 ... 49.
- □ Look&Link 1.01 ... 59.
- □ Ultravision 1.1 ... 79.
- □ @BASE 1.21 ... 119.

Pater Norton ... NCP
- ◙ Norton Editor 1.3 ... 39.
- ◙ Norton Commander 2.0 ... 45.
- ◙ Advanced Utilities 4.5 ... 79.
- ◘ Dan Bricklin's Demo Program 2 ... 99.

Querterdeck ... NCP
- □ Expanded Memory Manager 4.2 ... $39.
- □ DESQView 2.2 ... 79.
- □ DESQView 386 1.0 ... 115.

Reference Software ... NCP
- □ Grammatik III 1.06 *(electronic proofreeder)* 52.
- □ Reference File 1.0 *(pop-up DB manager)* ... 49.

Relay Communicatione
- □ Relay Gold 3.0 ... 149.

Revolution Software ... NCP
- ◙ VGA Dimmer 2.01 *(screen saver)* ... 19.
- ◙ DJ 1.5 *(disk meneger)* ... 39.
- ◙ Cruise Control 3.02 ... 39.

Rightsoft ... NCP
- □ Rightwriter 3.0 ... 54.

Simon & Schuster ... NCP
- ◘ Professional Thesaurus 1.0 ... 79.
- □ Typing Tutor IV ... 33.

Softlogic Solutions ... NCP
- □ Software Cerousel 2.02 ... 49.
- □ Disk Optimizer 4.01 *(w/Data Guardien)* ... 45.
- □ @Liberty 1.1 ... 119.
- □ Cubit 2.02 ... 45.
- □ Double DOS 4.02 ... 45.
- □ Megic Mirror 1.0 ... 59.

SoftView ... NCP
- □ TaxView *(for 1988 taxes)* ... 69.

Software Publishing ... NCP
- ◙ Professional Plan 1.01 ... 59.
- □ PFS:First Publisher 2.0 ... 79.
- ◙ PFS:First Graphics 1.0 ... 95.
- ◙ PFS:First Choice 3.01 ... 99.
- ◙ Professionel Write 2.0 ... 125.
- ◙ Professionel File 2.0 ... 189.
- ◙ Office Writer 6.0 ... 259.
- ◙ Harvard Grephics 2.12 ... speciel
- ◙ Harvard Graphics Accessones Pack ... speciel
- ◙ Harvard Project Maneger 3.0 ... 439.

Spinneker ... NCP
- □ Resume Kit 1.0 ... 25.
- □ Eight-in-One 1.1 ... 39.
- ◙ Splash 1.0 ... 59.
- ◙ Pinstnpe Presenter 1.0 ... 115.

Springboard ... NCP
- □ Newsroom Pro 1.0 ... 45.
- □ Certificate Meker ... 34.
- ◘ Clip Art 1 or 3 ... each 19.
- ◘ Clip Art 2 ... 25.
- ◘ Clip Art 3 ... 19.

Symentec ... NCP
- ◘ SQZ!Plus 1.11 ... 69.
- ◘ 4Word 2.0 ... 69.
- ◙ Q & A Write 1.01 ... 135.
- ◙ Grandview 1.0 ... 195.
- □ Q & A 3.0 *(databesa, word processor)* ... 235.
- □ *Breakthrough* Timeline 3.0 ... 395.
- ◘ Spreadsheet Anelyst 2.5 ... 99.

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ALL ITEMS SUBJECT TO AVAILABILITY PRICES SUBJECT TO CHANGE WITHOUT NOTICE

He'd have studied their looks

So hungry and lean.
And with a good database
Would know what they mean.

- Note-It Plus 1.02 ... $55.
- Think Tenk 2.4NP ... 135.

T/Meker ... NCP

- Scrapbook+ 1.0 ... 79.
- ClickArt Business Images ... 42.
- ClickArt Holidays ... 42.
- EPS (PostScript) Illustrations ... 79.

The XTREE Co. ... NCP

- XTREE Pro 1.0 ... 69.
- Hot 4.0 ... 95.

TOPS ... NCP

- Flashcard *(AppleTelk network card; 1 year warranty)* ... 169
- NetPrint 2.0 *(share printers)* ... 119
- TOPS 2.0 ... 119.
- TOPS Repeater *(extends network)* ... 132.

Traveling Software ... NCP

- Bettery Wetch 1.0 *(3½" only)* ... 27.
- Laplink Mac 2.0 *(Mac-PC transfer)* ... 79
- Laplink Plus 2.1 ... 85.
- Desklink 2.21 ... 99.

True BASIC, inc. ... NCP

- True BASIC 2.03 *(now includes Runtime)* ... 57.
- 3-D Graphics ... 45.

Vericomp ... NCP

- SoftBytes 2.0 ... 35.

WordPerfect Corp. ... NCP

- WordPerfect Library 2.0 ... 69.
- WordPerfect 5.0 ... 239
- WordPerfect 5.0 Addit'l Network Stations ... 84.
- WordPerfect Office 2.0 ... 269.
- WordPerfect Office 1.0 Addit'l Network Stations 84
- WordPerfect Network Server 5.0 ... 349.
- WordPerfect Executive ... 129.
- DataPerfect 1.0 ... 299.

Wordtech ... NCP

- DBXL 1.2 ... 119.

Xerox ... NCP

- Ventura Publisher 2.0 ... call
- Professional Extensions *(reqs. Ventura Publisher)* ... call

XYQUEST ... NCP

- XyWrite III Plus 3.54 w/A-la-Carte Menus ... 239
- XyWrite III Plus Network Server 3.54 ... 399.

RECREATIONAL/EDUCATIONAL

Accolade ... CP *(reqs. graphics brd.)*

- Bubble Ghost ... 22.
- Mean 18 ... 29.
- Hardball *(baseball simulation)* ... 11.
- Testdrive *(driving simulation)* ... 24
- Jack Nickleus' 18 Greatest Holes ... 29.
- Grand Prix ... 22.
- 4th & Inches *(football simulation)* ... 22.

Broderbund ... CP

- Where in the World is Carmen SanDiego? 25.
- Where in the USA is Carmen SanDiego? ... $25.
- Where in Europe is Carmen SanDiego? ... 29.
- Toy Shop ... 39.
- Ultima IV ... 35.
- Ultima V ... 39.

Electronic Arts ... CP *(reqs. graphics brd.)*

- One-on-One/Bird vs Jorden ... 29.
- Chuck Yeager's Flight Trainer ... 32.
- Chessmaster 2100 ... 32.
- Earl Weaver Baseball ... 32.
- Heroes of the Lance ... 29.
- Empire ... 35.
- Mavis Beacon Teaches Typing ... 35.
- Sentinel Worlds ... 39
- Bard's Tale II ... 39.
- Grand Slam Bridge ... 45.

Infocom ... NCP

- Zork Trilogy ... 33.

Microprose ... CP

- F-19 Stealth Fighter *(requires CGA or EGA)* 39.
- F-15 Strike Eagle *(requires CGA)* ... 22.
- Gunship *(requires CGA or EGA)* ... 32.

Microsoft ... NCP

- Flight Simulator 3.0 *(reqs. graphics brd.)* ... 35.

Mindscape ... CP

- Colony 1.0 ... 30.
- Balance of Power ... 33.
- Balance of Power 1990 ... 30.

One Step Software ... NCP

- Golf Doctor 1.1 *(improve your game)* ... $33.
- Golf's Best Pinehurst #2 4.0 *(play the best)* ... 12.
- Golf Statkeeper 1.0 *(includes USGA Handicapper)* ... 27.
- 19th Hole Special *(3 Golf programs above bundled with Mr. Boston Micro Bartender's Guide)* ... 79.
- Mr. Boston Official Micro Bartender's Guide ... 18.
- Micro Video Companion 1.0 ... 24.
- Teke Control of Cholesterol 2.0 ... 24.

Parlor Software ... CP

- Bridge Parlor 2.3 ... 49.

Sierra On-Line ... CP
(All require Hercules, CGA or EGA)

- Leisure Suit Larry ... 25.
- Leisure Suit Larry II ... 33.
- Space Quest II ... 33.
- King's Quest IV *(512k version)* ... 33.
- Manhunter ... 33.
- Police Quest ... 33.
- Police Quest II ... 33.
- 3D Helicopter ... 33.

Simon & Schuster

- Star Trek: Rebel Universe ... 29.

Spectrum Holobyte ... NCP

- Orbiter *(shuttle simulation)* ... 25.
- GATO *(submarine simulation)* ... 12.
- Tetris *(addicting mind teaser)* ... 24.
- Falcon *(F-16 simulation, reqs. graphics brd.)* 32.

Spinneker ... CP

- Sargon III *(chess game)* ... 15
- Kids on Keys *(ages 3 to 9)* ... 19.
- Facemaker Gold *(ages 3 to 8)* ... 25.
- Kindercomp Gold *(ages 3 to 8)* ... 25.
- Kidwriter Gold *(ages 6 to 10)* ... 32.
- Homework Helper—Math *(grades 7-12)* ... 32.
- Homework Helper—Writing *(grades 7-12)* ... 32.

Stone & Assoc. ... NCP *(reqs. graph. brd.)*

- Algebra Plus *(ages 13 to adult)* ... 27.
- Memory Master *(ages 2 to 6)* ... 22.
- My Letters, Numbers, Words *(2 to 6)* ... 22.
- Second Math *(ages 7 to 16)* ... 27.

Subiogic ... NCP

- Jet 2.1 *(requires EGA or CGA)* ... 33.
- Scenery Disks ... each 15.
- San Francisco Star Scenery Disk ... 18.
- Japan Scenery Disk ... 15.
- Up Periscope ... 19.

The Learning Company ... CP

- Math Rabbit *(ages 4 to 7)* ... 26.
- Reader Rabbit *(ages 4 to 7)* ... 26
- Writer Rabbit *(ages 6 to 12)* ... 26.

True BASIC, inc. ... NCP

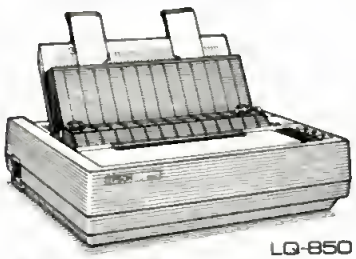
- Kemeny/Kurtz Math Series ... 32.

XOR ... NCP

- NFL Challenge 2.0 ... 69.

PC Connection Hardware Special

through March 31, 1989



Epson ... 1 year
Epson LQ-850

- 80 column printer with print speeds of 264 cps draft and 88 cps letter quality (12 cpi mode)
- SelecType control panel offers quick, easy selection of typestyles, font, and pitch
- Includes both parallel and serial interfaces, 6k buffer, and push tractor
- Full 1 year limited warranty

Epson LQ-850 ... call

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E tu compute

Can you see what's in view?
Just lend us your ears
And we'll help see you through.

HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

AST Research ... 2 years
I/O Mini 2 C/S/P ..... $89.
SixPakPlus 64k C/S/P *(upgrades to 576k)* 129.
Advantage Premium 512k S/P *(upgrades to 1 Meg or 2 Meg w/Piggyback)* ..... 369.
Advantage 2-386 *(for PS/2 Model 80)* .... call
RAMpage Plus 286 512k *(for XT286/AT)* .. 539.
RAMpage Plus MicroChannel 512k *(for PS/2 Models 50/60)* ..... 539.
Amdek ... 90 days
LaserDrive-1 *(external CD-ROM Drive)* ... 629.
LaserDrive-2 *(internal CD-ROM Drive)* ... 629.
Compucable ... 2 years
2-Position switch box ..... 29.
3-Position switch box ..... 39.
Cuesta ... 1 year
Datasaver 400 Watt *(standby power backup unit for the AT)*... 459.
Curtis ... lifetime
ACCESSORIES
Curtis Clip CC-1 ..... 6.
Disk Holder DB-1 *(holds 50 5¼" disks)* .... 8.
3½" Disk Holder DB-2 *(holds up 40 disks)* . 8.
Printer Stand PS-1 ..... 18.
Universal System Stand SS-3 ..... 25.
Toolkit TK-1 ..... 25.
CABLES
Smartmodem-to-PC Cable EC-7 *(9 feet)*... 17.
Printer-to-IBM cable EC-6 *(9 feet)* ..... 17.
SURGE SUPPRESSORS
Filtered SafeStrip SPF-3 ..... *21.*
Diamond SP-1 (6 outlets) ..... 29.
Emerald SP-2 ..... 36.
Ruby SPF-2
(6 outlets; EMI/RFI filtered; 6 ft cord)..... 55.
Ruby-Plus SPF-2 Plus
(w/FAX & modem protection) ..... 69.
DCA ... 1 year
Irma 2 *(3270 emulation board)*..... 729.
Irma 2 Micro Channel
(for PS/2 Models 50/60/70/80) ..... 729.
Epson ... 1 year
We are an authorized Epson Service Center.
FX-850 *(80 col., 264 cps, 9 pin)*..... call
FX-1050 *(136 col., 264 cps, 9 pin)* ..... call
LQ-500 *(80 col., 180 cps, 24 pin)*..... call
LQ-850 printer *(80 col., 264 cps, 24 pin)* .. call
LQ-1050 printer *(136 col., 264 cps, 24 pin)* call

PC Connection Hardware Special
through March 31, 1989

Hayes ... 1 year thru PC Connection
Personal Modem 1200 w/Smartcom EZ

Designed for unsurpassed ease of setup and operation, this home telecommunications system provides a complete solution. The compact size and sophisticated design of this new Hayes modem offers reliable communications and state-of-the-art technology, all at an affordable price.

- Personal Modem 1200 plugs into a standard wall outlet, eliminating the need for a separate power supply
- Attached cable included with 9 and 24-pin adapters for easy connection to your PC
- Smartcom EZ Software makes communications easy, with menus and a "phone book" for storing frequently called numbers

Hayes Personal Modem 1200 w/Smartcom EZ (3½" and 5¼" included)..... $145.

LQ-2550 printer *(136 col., 400 cps, 24 pin)* call
LX-800 printer *(80 col., 180 cps, 9 pin)*.... call
Printer-to-IBM cable (6 feet) ..... 15.
Everex ... 1 year
1200 Baud Internal Modem ..... 79.
2400 Baud Internal Modem ..... 149.
5th Generation ... 1 year
Logical Connection 256k ..... 449.
Logical Connection 512k ..... 499.
Hayes ... 2 years
Personal Modem 1200 *(with Smartcom EZ; 1 yr. wrty thru PC Connection)* ..... special
Smartmodem 1200 ..... 289.
Smartmodem 1200B *(with Smartcom II)*.. 289.
Smartmodem 1200B *(hardware only)*.... 259.
Smartmodem 2400 ..... 429.
Smartmodem 2400B *(with Smartcom II)* . 429.
Smartmodem 2400B *(hardware only)* .... 399.
Hercules ... 2 years
Graphics Card Plus ..... 189.

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SALES 603/446-7721 **FAX** 603/446-7791

Intel ... 5 years
2400B Modem *(internal modem for IBM-PC/XT/AT)* ..... $239.
2400B Modem 2 *(internal modem for PS/2 Models 50/60/80)* ..... 269.
Inboard 386/PC w/1 Meg ..... 729.
Inboard 386/PC Piggyback Card w/4 Meg ..... 1699.
Inboard 386/*AT (req. installation kit)* .... 899.
Inboard Installation Kit *(specify computer)* 139.
Above Board Plus 512k ..... 429.
Above Board 2 Plus 512k ..... 479.
Above Board Plus I/O 512k ..... 529.
Connection Coprocessor *(FAX board plus)* ..... 769.
Optional 2400 Baud Modem for Connection Coprocessor..... 229.
MATH COPROCESSORS
8087 *(for IBM-PC & XT)* ..... 95.
8087-2 *(8 MHz, for PS/2 Models 25 & 30)* 139.
80287 *(for AT & XT286)* ..... 149.
80287-8 *(for 8 MHz 80286 machines)* .... 219.
80287-10 *(for PS/2 Models 50 & 60)* .... 259.
80387 *(for 16 MHz PS/2 Model 80)* ..... 399.
80387-20 *(for 20 MHz PS/2 Model 80)*.... 459.
Kensington Microware ... 1 year
Masterpiece ..... 94.
Masterpiece Plus ..... 109.
Key tronic ... 3 years
101 Keyboard ..... 99.
101 Plus Keyboard *(enhanced layout)* .... 99.
Kraft ... 5 years
Three-button Joystick ..... 33.
High Speed Joystick Adapter Card ..... 25.
Adapter Card/3-Button Joystick Bundle.... 49.
KYE International ... lifetime
Dyna Mouse GM6+ *(w/Dr. Halo III)* ..... 54.
Logitech ... lifetime
Series 2 Mouse *(for PS/2 50/60/70/80)*.... 65.
HiREZ Mouse *(bus only)* ..... 89.
Mouse w/Paint Show *(bus or serial)* ..... 95.
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Magnavox ... 2 years
14" VGA Monitor *(9CMO62)* ..... 389.
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VGA Adapter *(9AV600)* ..... 249.
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Memory+Option *(for Mach 20; 1 yr. wrty.)* . 339.
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Mouse with Easy CAD *(bus or serial)* ..... 125.
MSC Technologies ... lifetime
OmniMouse *(serial only; 1 year warranty)*.. 57.

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For Caesar and the others

Are probably pledgin'
That the next time they'll consult
With PC Connection.

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ProDesigner VGA *(800x600 VGA Mode)* . 319.
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Breakthrough 286 Accel. Board *(12 MHz)* . . 449.

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T1200 Laptop *(80C86, 10 MHz, 20 Meg)* . . call
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Sony *(10 disks per box)* . . . . . $23.
Maxell MD2-HD *(10 disks per box)*. . . . . 23.
Verbatim Datalife *(10 disks per box)* . . . . . 22.

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Fuji *(10 disks per box)* . . . . . 19.
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3½" DS/High-Density Diskettes *(1.44 Meg)*
Sony *(10 disks per box)* . . . . . 55.
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Maxell *(10 disks per box)* . . . . . 59.

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- 120 day limited warranty on all products.*
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- Call 603/446-3383 for information.

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PC Carnival.

Revel without a Claus.

In the festive town of Marlow, NH (pop. 557), the holiday spirit lasts long after Santa's packed it in for the year. In fact our sure-pawed mascots are already preparing for their annual Winter Carnival – a seasonal celebration featuring skating, sledding, sleigh rides and ice sculpture. This annual event certainly provides a welcome break from our usual winter sports, e.g. thawing frozen pipes, jump starting cars, putting out chimney fires, and skidding off the road into ten foot snow drifts.

Breaking the mold.
(Or, where's the P word?)

Our more loyal and linguistically-inclined customers may have noticed that we've abandoned the "P" words in our headlines in favor of the "C" words. Because after five years of parading a profusion of P patter past PC pros on periodical pages, we perceived that perhaps they paled next to the possibilities and potential of creative constructions consisting of C words. 'Nough said. Rest assured, though, our letter-perfect mascots still stand (and occasionally sit, roll over, and do handstands) for everything true and noble in the microcomputer mail order marketplace. If you're looking for a single source for superior savings, sensational tech support, and specially speedy shipping, we're definitely your Connection.

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PC MAGAZINE FACT FILE

***OTIS*, Version 1.2**
Odin Research
834 Old State Rd.
Berwyn, PA 19312
(215) 296-4485
List Price: $995 for the first copy, $99 for each additional copy (site license).
Requires: 300K RAM, DOS 2.1 or later.
In Short: *OTIS* is designed for manipulation of time-series data. It is easy to learn and use, but lacks advanced built-in statistical functions. Its plotting and report capabilities are rudimentary, reflecting the program's design philosophy: its purpose is numerical manipulation, not fancy report-writing and graphics. *OTIS* has a powerful programming language with built-in simultaneous equation solving. Copy protected.
CIRCLE **647** ON READER SERVICE CARD

an if command and a corresponding else command, these cannot be nested. No other flow control commands, such as the much maligned Goto, are supported.

The language also contains a user-definable menu system so that turnkey applications can be written. The function keys can also be programmed.

Commands to customize the way the screen looks in small, prespecified ways are also part of the language. *OTIS* has 13 commands to set colors for different parts of the screen: background, foreground, command prompt, and so on. However, the basic appearance of the screen cannot be altered: it is the "glass teletype" view, in which the user types in commands that scroll off the top of the screen as the system responds to them.

Built into *OTIS* is a file handler that can store and retrieve time series to or from a disk file. By setting modes properly, the user can *update* a time series (copy all valid data from one to another), *overlay* one (copy all data, including missing data indicated by N/As), or even *total* them (add each new value to the existing one). The latter capability, for example, lets you retrieve General Motors' total monthly sales from a file that contains the sales figures for each car model without doing any programming.

OTIS was designed to be small and fast, so it does not have fancy graphic or report-writing capabilities, although you can write reports with programming. Actually, you'll have to export the raw data in ASCII format and then import it into a program designed for graphing or report writing. Unfortunately, *OTIS* also lacks many advanced statistical functions. In fact, the only built-in statistical analysis functions are least squares with auto-correlation correction, correlation and auto-correlation, ridge regression, and simple descriptive statistics such as mean, standard deviation, and minimum and maximum values. There is also a built-in Gauss-Seidel multiple simultaneous equation solver.

The help system is quite good, albeit primitive. Pressing F1 brings up a help screen, listing the available commands along with sample usages. The reference manual's description of the command is only a keystroke away. Unfortunately, *OTIS* looks only in the current directory for the Help files, which makes storing data in any other directory cumbersome.

The reference manual is simply a list of commands and options in alphabetical order; its index contains only commands, making them difficult to find unless you already know their names. The user guide is not particularly friendly, but it is straightforward. Using it, I calculated the correlation of my income with my income tax within 15 minutes of opening the package.—**Seth Breidbart**

PowerStation

Alphametrics' $895 *PowerStation*, Version 1, comes close to being a turnkey application program for economists and business analysts. While the statistical techniques available through the program are limited to the tasks that economists are most likely to perform, *PowerStation* makes these tasks quite simple. Macros and a command mode make it easy to automate frequently repeated tasks, such as plotting forecasts from economic data updated monthly.

PowerStation's key features are its ability to produce publication-quality plots of time-series data, plot regression curves, and forecast these trends to any period in the future. Data series can be weekly, biweekly, monthly, quarterly, or annual in frequency.

A simple, menu-driven system leads the user through loading of data, conversion or transformation of series, production of tables, plotting of trends, statistical analysis, and regressions. Though it unfortunately accepts invalid text from fill-in screens (if, for example, you enter a nonsense string in one of its start-up options, instead of warning you of your error, the program simply won't branch to analysis mode from the main menu), helpful text at the bottom of the screen explains the expected input at each of the system's menu steps.

PowerStation accepts data from a multitude of sources, including its own .TSD format (supported by WEFA Group, Haver Analytics, Datastream, and Data Resources Inc.). The proper format for input ASCII or spreadsheet files is clearly noted in the documentation, which makes it easy to prepare your own time-series data for analysis with the software. Time-series data in ASCII files can be stored as either rows or columns but must be in fixed-format fields. Missing data must be indicated by "NA."

PC MAGAZINE FACT FILE

***PowerStation*, Version 1**
Alphametrics Corp.
11 E. Princeton Rd.
Bala Cynwyd, PA 19004
(215) 664-6480
List Price: $895, basic version; $1,800, limited version; $2,300, full package; *BLUE* add-on module, $500.
Requires: 580K RAM, hard disk with 1.5MB free space, 8087, 80287, or 80387 math coprocessor; CGA, EGA, or Hercules compatibility; DOS 3.0 or later.
In Short: *PowerStation* is a menu-driven package for econometric analysis, featuring data plotting, forecasting, descriptive and comparative statistics, and time-series regression. User-created menus allow access to popular spreadsheet, word processing, and file-management programs directly from *PowerStation*. Copy protected.
CIRCLE **646** ON READER SERVICE CARD

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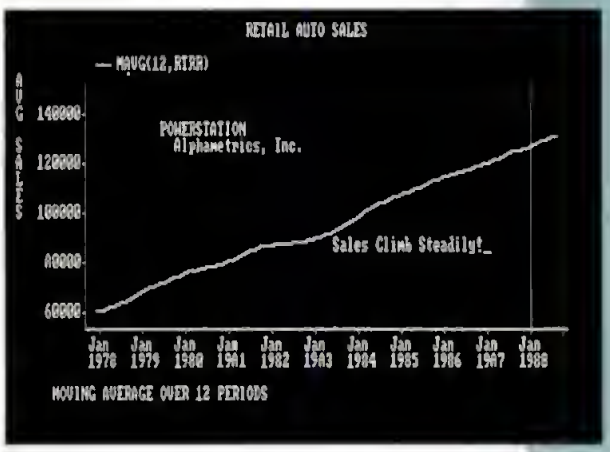

PowerStation performed an analysis of this single-variable data series, and then displayed this graph showing the moving average over time.

PowerStation will perform regressions with auto-regressive corrections as well as polynomial distributed lags. Simple y/n toggles on the regression menu turn these statistical adjustments on or off. In addition, variables can be transformed in the regression by a number of arithmetic functions (percent change, exponent, logarithm, absolute value, trig functions, and so on).

A key strength of *PowerStation* is its ability to tie in to other programs.

Regression output screens can be saved on-disk and transferred to a word processor. The actual, predicted, and residual values can also be displayed, both as a graph and as a data table, and these values can be saved to the program's databank for further analysis.

PowerStation currently lacks the ability to perform ARIMA analysis. However, Alphametrics claims to be working on an ARIMA function for a future release of the product. The program does have the U.S. Census Bureau seasonal adjustment transformation built in, so subannual data can be automatically adjusted to take account of seasonal economic factors.

PowerStation is extremely nimble, changing modules or displaying graphs on our 8-MHz IBM PC AT in less than 2 seconds. And well-written documentation makes learning the program a breeze. For expert users, a command-driven analysis program with on-line help is available from the main menu. Any series of menu steps or data transformations can be recorded as a macro as well.

An important feature of *PowerStation* is its ability to tie in to other programs. From the main menu you can access a spreadsheet or word processing program; from the utilities menu you can jump to a DOS shell or a file manager such as *PC Tools* or *DR*; and any graph or report can be output in a form that can be read by *Ventura Publisher*, Aldus's *PageMaker*, or Scientex's *Protex*. Spreadsheets supported by *PowerStation* include *Lotus 1-2-3*, *Symphony*, *Quattro*, and *Excel;* word processors that may be called directly from the program include *WordStar*, *Microsoft Word*, *WordPerfect*, and *XyWrite*. The program can print graphs directly to disk or to IBM or Epson dot matrix printers, HP pen plotters, or HP laser printers.

Many of Alphametrics' users have custom installations in which *PowerStation* is integrated into a larger turnkey system. The company offers custom programming and very good customer support, including user-training conferences. If econometric plotting, forecasting, and analysis is your game, it would be hard to go wrong with *PowerStation*.—**Frederick Barber**

Soritec

Soritec, $595 from the Sorites Group, is a versatile and powerful econometric package. It can estimate, solve, and forecast a wide variety of econometric, time-series, and financial models in an easy-to-use environment.

Soritec offers a vast array of econometric methods, including many recent advances in econometric theory. In addition, *Soritec* has a powerful programming language that lets you program your own routines using matrix algebra functions, analytical differentiation, and many other techniques. Even if a feature you require doesn't already exist in the program, you can build it with these programming tools.

PC MAGAZINE FACT FILE

***Soritec*, Version 6.3**
Sorites Group Inc.
P. O. Box 2939
8136 Old Keene Mill Rd.
Springfield, VA 22152
(703) 569-1400
List Price: $595; $150 optional annual service support contract (support is free for the first 60 days).
Requires: 441K RAM, hard disk, math coprocessor, DOS 2.1 or later.
In Short: *Soritec* is easy to use, powerful, and versatile. It can estimate, solve, and forecast a wide variety of econometric, time-series, and financial models. Its sophisticated modeling techniques will satisfy the most discriminating econometricians; its logical, yet powerful, command language will please both the econometric tenderfoot and the master. Not copy protected.

CIRCLE 645 ON READER SERVICE CARD

Who Has The Best Storage Solutions For NetWare®? Ask Novell.®

Novell, the biggest name in high-performance network operating systems, has joined with Storage Dimensions to co-develop high-capacity NetWare storage.

Storage Dimensions will now co-develop and market storage subsystems for NetWare that meet Novell's stringent standards for quality and reliability.

According to James C. Bills, executive vice president of Novell Sales and Services Group, "This agreement will allow users to acquire high-performance storage products directly from Storage Dimensions while being guaranteed of quality, reliability and NetWare compatibility."

In fact, the Storage Dimensions and Novell names already appear on the NDS storage subsystems.

115 to 1,300 MB subsystems

Storage Dimensions' LANStor hard disk subsystems provide the industry's highest performance over a wide range of capacities. Both internal and external models are available from 115 MB to over 1,300 MB with support for all popular interfaces — including MFM, ESDI, SCSI and DCB. Each is 100% compatible with NetWare. And every one installs quickly and easily, without COMPSURF.

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The Storage Dimensions and Novell partnership is just the first step in providing delivery of new, lower-cost NetWare storage technologies.

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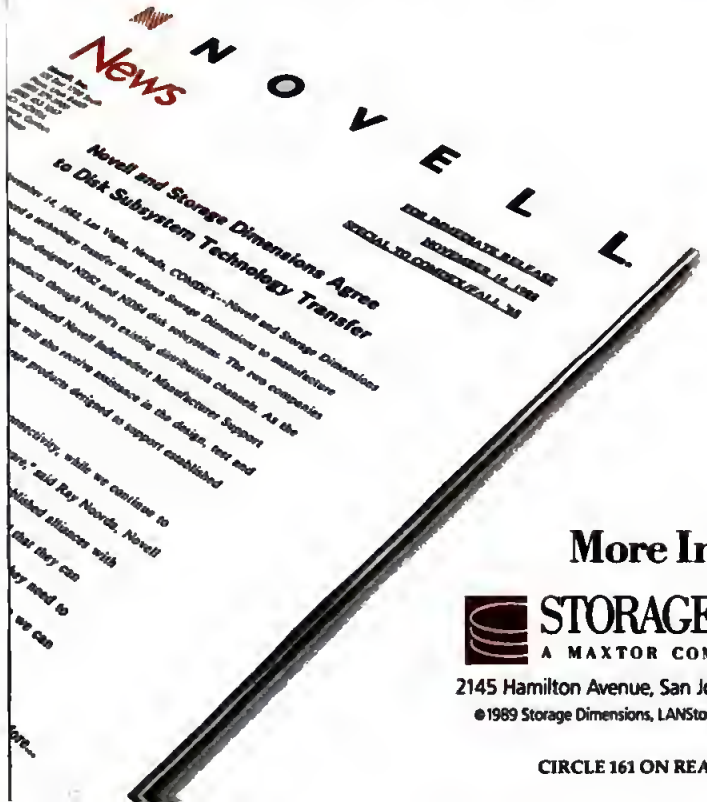
Just ask Novell.

For more information, call (408) 879-0300



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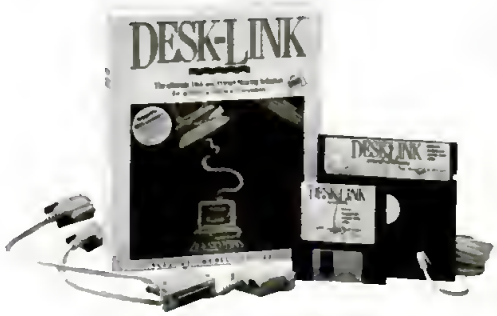
DESK-LINK 2.0 Makes Disk and Printer Sharing a Snap.



Now there's one easy solution that lets your two desktop computers share files, a printer, even a single hard disk, all with just a snap. It works just like a mini-network.

DESK-LINK® from Traveling Software, the makers of the award winning LAP-LINK®.

DESK-LINK® allows you to connect two IBM or compatible computers, including the new PS/2 and laptops, with just phone wire and DESK-LINK® software. Once connected, disk-, printer-, and file-sharing works completely in the background. And with dual print spooling, you can use printers on either computer at the same time — without interrupting either machine. DESK-LINK® also comes with a pop-up "Talk Box" function for sending messages back and forth between computers, even while using your favorite applications.

DESK-LINK® comes complete with everything you need. It includes both 5¼ and 3½ inch diskettes, universal connectors, and 25 feet of RJ11 standard telephone cabling (which can be extended to 100 feet). The documentation is straightforward and easy to understand.

Best of all, DESK-LINK® installs painlessly in minutes using your computer's serial port. No add-in board is required. It has incredible communication speeds of 115,000 baud and supports EMS memory. Plus, DESK-LINK® is compatible with Novell, 3Com, and Token Ring networks.

So if you're looking for a fast, inexpensive way for your two computers to share files, printers, or hard disks — all completely in the background — snap up DESK-LINK® today. You'll find it at your local computer store for $169.95 — that's less than $85.00 per computer! For more information call: **1-800-343-8080**, or **1-206-483-8088**.

Traveling Software

CIRCLE 223 ON READER SERVICE CARD

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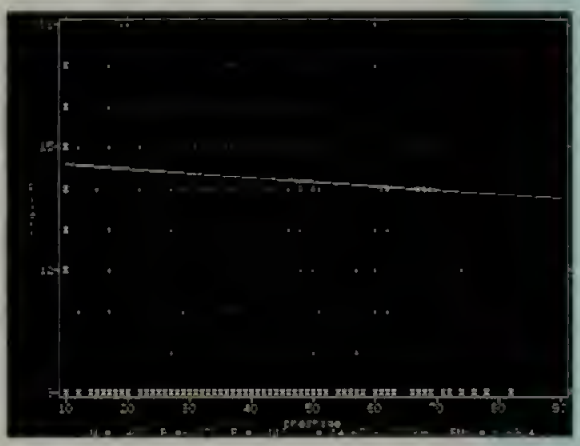
A Day in Five Lives: Social Science Research

Task 3

This test was based on an analysis of e survey designed to study public opinion and attitudes, as printed in *The Practice of Social Research* by Earl R. Babbi. The dete was extracted from the 1985 General Social Survey; the full data set included 1,534 cases and about 350 questions. We selected 21 variables presented to 677 cases in order to study the respondents' views of political efficacy. Reviewers received a complete data set and a mini data set that was used for the data-cleening component of the exercise.

To analyze the date, we

- applied data-cleaning techniques to rid tha data set of input arrors and illegal characters;
- assigned missing valuss to answers such as "can't choose," "no answer," and blanka;
- appiied descriptiva statistics mathods to tha data;
- performed data transformations and recoded values;
- applied descriptiva statistics mathods to recoded variables and plotted histograms and bar charts whare possibla;
- performed a reliability anatysis on variables;
- crested an index of the sum of the values of the variables;
- performed correlation tasts between the index and each of the five variablas, and than recoded tha index;
- performad a crosstab of tha index by *race* controlling for *sex*;
- reported the results in a publication-quality tabla.



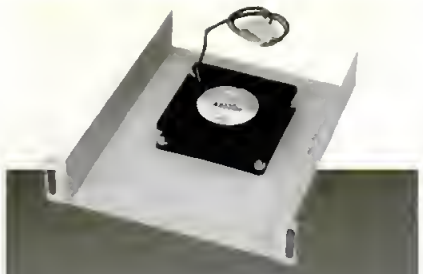
BMDP/PC produced a scatterplot of the recoded variables.

Statgraphics performed frequency statistics on all variables after the data was transformed and the variables were recoded.

Soritec, however, is not beyond the reach of the econometric tenderfoot. The program has a simple, logical command structure, adding numerous error- and potential error-trapping facilities to help users avoid dubious results. *Soritec* commands are explained clearly, with many examples in a bulky but informative user manual.

Your interactive sessions with the program are entered into a journal file. You can edit this file to remove errors and then rerun it in batch mode or as an interactive macro-type file. Programming *Soritec* to perform interactive routines is as easy as writing BASIC code or *Lotus 1-2-3* macros. In fact, the combination of sophisticated techniques with a simple command structure makes *Soritec* a very powerful pedagogical tool.

The primary strength of *Soritec*, however, lies in its sophisticated modeling facilities. Economists rely on models to explain how the world works, and the value of these models depends greatly upon how well they perform in statistical tests. *Soritec* allows easy (and correct) estimation and testing of economic models, offering many esoteric "cutting-edge" techniques, including full- and limited-information maximum likelihood, seemingly unrelated regressions, restricted least squares, and transfer functions (Box-Jenkins, for example). Furthermore, the program generates



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STATISTICAL ANALYSIS ● ECONOMETRIC MODELING

PC MAGAZINE EDITOR'S CHOICE

- **Soritec**

Although the products reviewed in this category all have somewhat different missions, one product has a strong general econometric appeal. Soritec, *from the Sorites Group, is a very sophisticated econometric modeling and forecasting program that can solve, simulate, and forecast a broad range of economic and financial models in a relatively friendly user environment.*

Although Soritec *is best suited to individuals with sophisticated research needs, it's also an excellent pedagogical tool. It's easy to use for basic statistics but possesses enough versatility and sophistication to satisy those who don't want to quickly outgrow their econometric software.*

an extensive menu of descriptive statistics for you to choose from to test your hypothesis. Economists using *Soritec* can be reasonably confident in the package's ability to tackle most modeling problems—a tremendous plus.

Soritec commands are basically the same in the 25 different environments in which the program is available, so files created on one system are easily transportable to other environments. However, this transportablilty has its pluses and minuses. On the positive side, once you learn *Soritec*, it doesn't matter which system you operate on—it always functions the same way. On the negative side, innovations, changes, and updates must take place across a multitude of environments, slowing the process. But judging from the plethora of new techniques available in the version of *Soritec* we tested, it seems that the Sorites Group is managing admirably.

To maintain compatibility with mainframe versions, the PC version of *Soritec* is contained in a single, very large file that requires tremendous amounts of free RAM. This may dictate some reconfiguration of your PC's AUTOEXEC.BAT and CONFIG.SYS files and may prevent use of the program on some networks.

Data retrieval from outside the *Soritec* environment is extremely sensitive: *Soritec* makes strict assumptions on the form of the files it reads in. This can be extremely frustrating, especially for newcomers to the package.

A shortcoming of *Soritec* for PC users is the program's limited graphics capabilities. Although its graphics are improving (it now supports graphics cards), *Soritec* will never rival many packages developed on the PC in terms of graphics. *Soritec*, as a sophisticated econometric package, relies less upon looks and more upon substance—it supplies simple numerical answers to complex economic modeling problems, not a complex presentation of simple statistical results. If you view statistics as simply graphs and charts, *Soritec* is probably not the right package.

Soritec relies less upon looks and more upon substance. It's a package hard to outgrow.

All in all, *Soritec* is a very powerful econometric program, best suited for individuals with some interest in economic research or economic policy modeling. It is easy to operate but will not be quickly outgrown by its users. Although *Soritec* is best at time-series economic models, it offers many cross-sectional techniques. *Soritec* should fulfill most research interests in the fields of economic and financial modeling.—**John R. Connelly**

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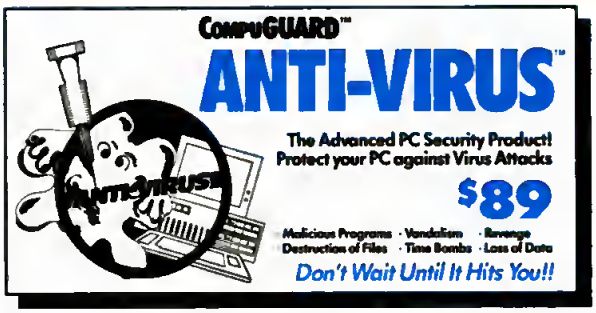

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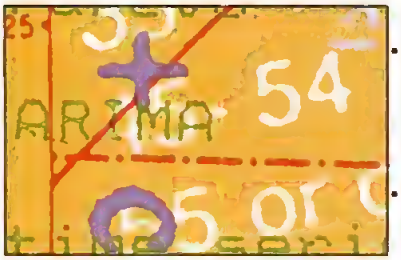

FORECASTING

Forecasting differs in many ways from general statistics. It is especially concerned with how data changes over time and how it will evolve in the future. It assumes that the processes underlying the data will continue into the future, so that past experience can be extrapolated to provide forecasts.

A good forecaster is pragmatic, using whatever works to give a good forecast. Thus, packages designed for forecasting allow methods and models that may amount to, from the point of view of conventional statistics, a witch's caldron of ad hoc techniques.

To test a forecast procedure, users generally perform ex post facto forecasting, whereby some of the actual data is set aside while a forecast is developed. The "forecast" and actual are then compared to see how well the method works. The ease with which such data manipulation and comparison can be carried out is important for users of a forecasting package.

AutoBox Plus

AutoBox Plus, Version 2.0, is a sophisticated time-series analysis program that offers both automatic and user-defined ARIMA forecasting methods. In addition to utilizing the standard Box-Jenkins methodology, Automatic Forecasting Systems' $1,195 program offers intervention detection and transfer-function capabilities. Also included with the program are modules for moving average, exponential smoothing, trend curve, and basic regression analysis.

Internal data management is quite primitive in *AutoBox Plus*. The user can enter series directly, but cannot list the series or execute any but the most simple arithmetic transformations. However, with a reliable text editor, the user can edit data from any source and make it available for ASCII import to *AutoBox Plus*. Automatic Forecasting Systems promises to include more-advanced editing capabilities in the next release.

Although *AutoBox Plus* is designed for ARIMA-based modeling and forecasting, it can report descriptive statistics on data samples containing fewer than 300 observations. When running through the economic forecasting task, the package performed the basic regressions without any correction for autocorrelation. However, *AutoBox Plus* performed admirably at forecasting through the use of ARIMA methodology.

To evaluate this program, we concentrated on comparing *AutoBox Plus*'s capabilities as an automatic forecasting algorithm versus a nonautomatic forecasting algorithm. Indeed, the user's ability to choose between automatic and manual forecasting modes is one of the program's best features.

The automatic method is based on an efficient expert system that will determine the optimum model specification for a given time series. This method uses standard Box-Jenkins criteria, as well as sophisticated diagnostic procedures for testing sufficiency, invertibility, and necessity in the identified model. By allowing the user to bypass the interactive mode and to fully program automatic modeling and forecasting through *AutoBox Plus*'s batch facility, the automatic approach is made even more powerful. Since the analyst can override the automatic mode, *AutoBox Plus* provides a marvelous medium for testing theory.

The more advanced user will be impressed by this program's ability to provide full transfer-function modeling for more than one input series, as well as an option for detecting structural shifts in a series by testing for intervention. Another unique feature of *AutoBox Plus* is its data simulation module. Within this module, the user can simulate time-series data based on one of three general classes of models: univariate ARIMA, transfer function, or vector ARIMA.

Also of great use to a sophisticated analyst are *AutoBox Plus*'s batch and customizing facilities. Using these facilities, you can save time during automatic modeling procedures by setting your own defaults and bypassing much of the program's interactive mode.

AutoBox Plus is highly recommended for someone in need of an easy-to-use, yet sophisticated, time-series modeling and forecasting package.—**Anthony J. Tilke**

PC MAGAZINE FACT FILE

***AutoBox Plus*, Version 2.0**
Automatic Forecasting Systems Inc.
P.O. Box 563
Hatboro, PA 19040
(215) 675-0652
List Price: For full system including five modules, $1,195; individual modules: *AutoBox*, $995; Boxx, $695; SIMBoxJ, $195; AFSEZF, $195; AutoBJ, $595.
Requires: 400K RAM, DOS 2.0 or later.
In Short: *AutoBox Plus* offers complete Box-Jenkins single-equation modeling, including both automatic and nonautomatic modeling. Three types of models are supported: ARIMA, transfer function, and intervention. Also included is a time-series simulator, that creates artificial time series according to a user-defined ARIMA or transfer function equation. Not copy protected.
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Autocast II

Finding a forecasting package that's slicker and better designed than *Autocast II*, $495 from Levenbach Associates, would be difficult to do. As far as analyzing future trends and seasonal cycles goes, this package has it all.

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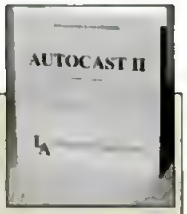

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Morristown, NJ 07960
(201) 285-9248
(201) 267-9269
List Price: $495; Batch 1, $2,900; Batch 2, $2,900.
Requires: 512K RAM, DOS 2.0 or later.
In Short: A sophisticated, versatile forecasting package. Even the most discriminating user is likely to be impressed. As a forecasting package, *Autocast II* has got everything. Not copy protected.
CIRCLE 657 ON READER SERVICE CARD

Installing the software is simple. *Autocast II* automatically determines what hardware you're using and configures itself to suit. Your equipment determines if you'll buy the version for systems with a math coprocessor or the one for systems without it; in either case, the program supports a mouse and monochrome and all color graphics standards up to VGA. Because the program is completely loaded into memory, it runs equally well on both floppy disk and fixed disk systems.

Using *Autocast II* is almost as easy as installing it. The program is run via well-designed menu and submenu screens. You can use function keys, number keys, or highlight bars to make your choices. Since the program's default is automatic forecasting mode, all you have to do to prepare a forecast is feed data into the program's editor and then chose F3 or *Autocast II* on the main menu.

The package's spreadsheet-style editor makes entering data a pleasure. The editor allows you to import .WKS and .WK1 files directly; although files are limited to a maximum of 500 data items, you can forecast using any subset of a larger file's data.

Autocast II will test your data for seasonality, choose an appropriate model, and then run the analysis. The program relies on exponential smoothing to produce a conservative and reliable forecast.

The forecast plot is nothing short of slick. On an EGA monitor, different colors distinguish actual data, fitted data, and the forecast. Unfortunately, *Autocast II* doesn't support color printers, so a printout of the graph won't have the same impact. The available summary reports are well designed and provide model-fitting data, fitted values, error and trend figures, and forecast values.

You can print either the summary reports or the forecast plot to a variety of popular printers, including all Epson models, IBM Proprinters, and the HP LaserJet II. If you're using the Epson or LaserJet II, you can also select modes or dots per inch (dpi).

Autocast II's utility really becomes apparent when the program is run in manual mode. This is done by choosing the Parameters option on the main menu. Parameters allows you a wide range of modeling, simulation, and analysis choices, without turning the process into a tedious nightmare. Since a single model may not yield a reliable trend, the value of being able to choose from 12 different types of models is obvious.

The program gives you control over the full range of statistical methods used, including probability distribution, confidence limits, variance analysis, and autocorrelation analysis, as well as a full range of data transforms.

The whole process is supported by the concise manual. It includes a short, step-by-step section that's enough to get anyone up and running in automatic mode in less than 15 minutes. The remainder of the manual contains detailed instructions on all the menu choices, sets forth the logical and mathematical basis for those choices, and includes a number of excellent examples and tutorials.

Installing *Autocast II* is simple—and using it is almost as easy.

Don't expect to get much out of the manual if you don't have a background in statistics, though. Although a novice could use automatic mode to produce a reliable forecast, anyone lacking experience won't get beyond that.

Users who have to make many forecasts could find two separately available, high-speed versions of *Autocast II* useful. Both versions, *Batch 1* ($2,900) and *Batch 2* ($2,900), perform automatic forecasting of all data files in a subdirectory. *Batch 1* is designed to work with files downloaded from mainframes, and it requires those files to be in *Autocast II* or ASCII format. *Batch 2* is designed to work with data stored in .WKS or .WK1 files; it produces hard-copy output only.

Autocast II's sophistication and versatility are unsurpassed. Sophisticated users will have to go a long way to match the features and ease of use this package offers.—**Walt Rowinsky**

Forecast Master

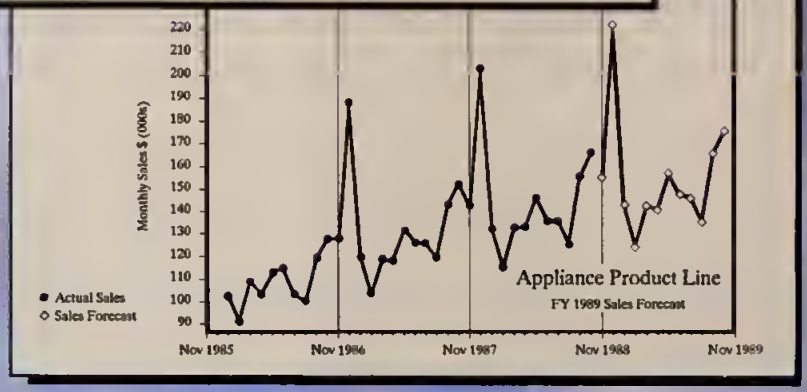
About 5 years ago the Electric Power Research Institute (EPRI), a nonprofit organization serving the electric power industry, contracted with Scientific Systems to write a personal computer forecasting package. The resulting product, *Forecast Master*, was a *PC Magazine* Editor's Choice in the August 1986 review of business forecasting software. It was cited as a "highly advanced program that can also be operated from menus."

At the time of its introduction, *Forecast Master*, with its simple menus, context-sensitive help screens, and powerful statistical technique, surpassed many of the higher-priced, harder-to-use mainframe statistical packages then available. And while *Forecast Master*, Version 2.0, priced at $595, remains a powerful forecasting tool, in the 2 years since its last major release, the competition has overtaken this product in terms of ease of use, sophistication, and price-performance ratio.

Indeed, Robert L. Goodrich and Eric Stellwagen, the authors of *Forecast Mas-*

Make expert business forecasts in minutes—with Lotus® and TrendSetter Expert™.

Series Type:	Monthly	Date	Forecast	Upper	Lower	S Factor
First Actual:	1	Nov 1988	159	158	153	1.03
Confidence		Dec 1988	221	225	217	1.49
Level:	95.0%	Jan 1989	143	148	139	0.95
Interval:	3	Feb 1989	124	130	119	0.82
Mean:	129	Mar 1989	143	149	137	0.94
Std Deviation:	24	Apr 1989	141	148	135	0.92
Minimum:	91	May 1989	157	164	150	1.01
Maximum:	203	Jun 1989	147	155	140	0.94
Trend Line Slopes		Jul 1989	148	156	140	0.93
Entire Range:	1.29	Aug 1989	135	144	127	0.88
Last Half:	0.98	Sep 1989	198	174	137	1.04
Seasonality		Oct 1989	170	185	156	1.10
Auto(+):	12					



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4. "Go".

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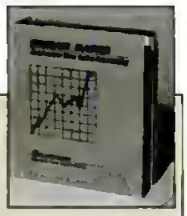
FACT FILE



***Forecast Master*, Version 2.0**
Scientific Systems Inc.
One Alewife Pl.
Cambridge, MA 02140
(617) 661-6364
List Price: $595; academic single copy, $350 (site licenses available).
Requires: 512K RAM; CGA, EGA, VGA, or Hercules compatibility; DOS 2.0 or later.
In Short: *Forecast Master* is a sophisticated forecasting package for the professional statistician. Professionals and mathematicians will like the freedom in this full-bodied program to choose options instead of having to rely on imposed options. Supports the 8087 and 80287 coprocessors. Not copy protected.
CIRCLE 656 ON READER SERVICE CARD

ter, left Scientific Systems in 1986 and went on to write the innovative *Forecast Pro* (see review). They now have a contract with EPRI to write *Forecast Master Plus* (probable release this year), a package to which Scientific Systems holds no rights. Considering this, and that there are no current plans to upgrade *Forecast Master*, one would be hard-pressed to justify a purchase from Scientific Systems without a need for some of the package's special functions.

Forecast Master features a comprehensive set of statistical techniques for multivariate and univariate time-series forecasting, including state space forecasting, Box-Jenkins, exponential smoothing, Bayesian vector autoregression, curve fitting, Autopro regression, and seasonal decomposition. Two additional techniques, both suitable to the needs of the electric power industry, are available: VPR (variable parameter regression) and ARCH (autoregressive conditional heteroscedastic) models.

Forecast Master has an annoying habit of asking for a carriage return for nearly every command entered. "Confirming" carriage returns are best left to important, dangerous, and irretrievable actions like reformatting your hard disk, not for confirming a menu choice.

The package also fails to support many of the PC's special function keys. For example, the Del key won't delete a variable name; you must overwrite using the Spacebar. And only the Tab key will move you among the menu choices—the arrow keys will not work.

The menus are easy to follow, and the pop-up help screens explain complex statistical concepts, but still you must have an advanced understanding of forecasting to use this product properly.

As with other forecasting packages, your first step is to import your data files. *Forecast Master* allows only one file format, a single time series in ASCII format; if your data is held in a database or spreadsheet, you must individually write each variable to a separate .PRN file.

Time-series data must have a reference to time. This is accomplished by making a KEY file containing the calendar and a brief description of the variable.

If you wish to transform the variables in your forecast, you must do so in the 35-character field allowed on the input screen. Even a relatively simple formula to calculate the percentage change between elements of a variable:

```
_%SALES = (SALES-SALES[-1])
/SALES[-1]*100
```

requires 39 characters. If you shorten the variable names to "_%X", your graphs and reports will display "_%X" instead of "_%SALES".

Trying to build a formula one step at a time fails as a work-around since you cannot use a defined variable (one beginning with a "_") in another formula. Yet there is a solution. *Forecast Master* does let you write a defined variable to disk as a file. You may refer to that file by its filename, (%SALESDIF, for example) within *Forecast Master* and not lose the descriptive name on your graphs or table results.

Forecast Master requires that the dependent variable appear first in the list of variables. This is awkward when you decide you must perform a transformation on the variable. You then overwrite the original variable with the new definition. To its credit, however, the package does allow use of your favorite ASCII editor from within *Forecast Master* to modify your data files.

Interestingly enough, since *Forecast Master* was written by the same authors as *Forecast Pro*, the file structures and key files are identical, and an upgrade to *Forecast Pro* would be smooth. Something for Scientific Systems to think about, perhaps?—**Robert C. Ullrich**

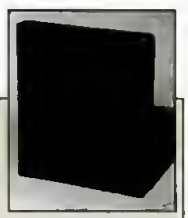
Forecast Plus

Walonick Associates' *Forecast Plus* is designed for users who know something about forecasting. At $595, Version 2.1 offers access to a number of data analysis and forecasting methods, with considerable flexibility for the user to set control parameters.

Using *Forecast Plus* is not trivial. The programs, which were written in BASIC, use a menu structure wherein the user supplies numeric choices to select the action to be carried out. Once a method is selected, the user may have to respond to a number of questions to select options. While defaults are provided, checking each one can be tedious. We think the process for setting the choices could be streamlined, but prefer the *Forecast Plus* mechanism to one that hides the choices from the user.

In plotting, the accent is also on technical capability. The provision of a number of plots for each method allows for a fairly complete analysis of the situation. These

FACT FILE



***Forecast Plus*, Version 2.1**
Walonick Associates Inc.
6500 Nicollet Ave. South
Minneapolis, MN 55423
(800) 328-4907
(612) 866-9022 (in Minn.)
List Price: $595
Requires: 256K RAM, DOS 2.0 or later.
In Short: *Forecast Plus* is a fairly complete forecasting package, designed for the serious user who understands the methods and difficulties of forecasting. It allows detailed exploratory and forecasting analysis, with automatic execution of batched instructions. Not copy protected.
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ATTRACTIVE ALTERNATIVES: LOTUS 1-2-3 ADD-ONS

Lotus 1-2-3 gives you the ability to calculate basic statistical measurements, such as standard deviation and variance, using built-in commands. However, if you need to perform a more sophisticated analysis, you must enter complex statistical formulas by hand. Fortunately, there exists an alternative to this tedious task in the form of *Lotus 1-2-3* add-on packages.

Add-on packages can save you both time and money. They can save you time by freeing you from the need to enter complex statistical formulas and by allowing you to use data you already have saved in *Lotus 1-2-3* format. And, if one of these packages meets your needs, it is an inexpensive alternative to standalone statistical analysis packages, which often cost several times as much.

In essence, all of these packages work in the same manner. After loading *Lotus 1-2-3* and a statistical analysis template, you input the data you want analyzed. The appropriate calculations are automatically performed, and the results are presented in table form. In addition, these packages let you view the results graphically.

The various add-ons can be distinguished by the way they use menus, the types of analyses they can perform, and the quality of their user documentation.

Forecast! for 1-2-3

Forecast! for 1-2-3, $145 from Intex Solutions, is extremely easy to use, but as its name implies, is designed to perform two broad statistical procedures—time series analysis and regression analysis.

A time-series worksheet in Version 2.1 allows you to analyze up to 150 periods of historic data with equal time intervals between each data point, and to generate forecasts based on that information. Manipulating data to define trends and analyze residuals, adjusting for seasonality, performing decomposition analysis, and exponential smoothing are easily accomplished by following examples in the user manual. However, results of forecasting using seasonal data may be imprecise because they require you to make assumptions about seasonal factors.

A multiple-regression worksheet permits you to determine statistical relationships between one dependent variable and up to ten independent variables. You can create a new variable from existing independent variables or from a formula, a useful capability.

Both worksheets can display data, trends, and residuals on-screen, an especially helpful analytical tool. Worksheet screens are standard, and although not difficult to read, would be more meaningful if you could customize them.

Forecast! for 1-2-3 is supported by an excellent user manual which contains several sections that can enhance your knowledge and comfort with statistical analysis. The manual also helps you learn the program, by guiding you through several examples. If your statistical-analysis needs are limited to time-series and regression analysis, *Forecast! for 1-2-3* is a good buy.

Add a Stat and Multifit

Add a Stat and *Multifit*, both from Abacus Scientific Software Company, feature many similar functions.

Add a Stat, $79.95, provides programs for linear regression, t-tests, chi-square, Poisson, analysis of variance, and error bar plots. When performing any of these tests, you must input pairs of data in ascending order. Otherwise, data has to be entered into a separate worksheet, sorted, and then reentered into the main worksheet.

Multifit, $89.95, performs multiple regressions, trend analysis, and linear exponential smoothing. If you don't enter data in ascending order when using trend analysis, several additional steps are necessary before it can be loaded into the worksheet. Unfortunately, the benefit of this analysis as a forecasting tool is minimized because the program is capable of projecting values only one period into the future.

The value of using the multiple-regression analysis is moderated by the program's limitation of only being able to use three independent variables to describe a dependent variable. However, *Multifit*'s ability to produce a matrix of the correlation coefficients between all of the factors is an attractive feature.

Screen and summary reports used throughout the programs are confusing because they require you to page through several screens to view all the information. And they appear sloppy because they include a great deal of extraneous data. Each package includes graphing capabilities, but the number of steps involved to produce a graph reduces the positive contribution it makes to analyzing test results.

Add a Stat and *Multifit* share a single user manual. The material does little to advance your knowledge of either statistics in general or, more importantly, your ability to effectively use the software. Instead of step-by-step examples of how to load and manipulate data and then interpret the results of the various worksheets, examples in the manual present data and the results that would be expected by using the statistical method being discussed.

Stat-Packets

Stat-Packets, from Walonick Associates, consists of 23 separate modules, each of which performs a different statistical analysis. Modules are priced at $24.95 each, or you can buy prepackaged bundles of modules that apply to a specific business sector—such as Mar-

keting Research, Manufacturing, Health/Medical, Forecasting or Science/Engineering—for $89.95.

After a particular module, you must specify which worksheet you want to use, select what type of analysis to perform, indicate the range of data to use, and select which options to employ in a given analytical procedure. The module then presents a comprehensive analysis of the test being used, and you can see the results displayed in graph form.

Walonick Associates provides a single manual, divided into two broad sections, for all 23 modules. The first part introduces you to the main components of the system and leads you through the process of designing and analyzing worksheets. The second section addresses each of the 23 modules in greater detail. Also included in this section is a guide as to who might use a test and formulas. However, the manual doesn't include specific examples of how to use each of the modules.

Stat-Packet modules are a logical choice for someone who regularly performs a specific type of statistical analysis. However, if you perform a wide variety of statistical analyses, the cost of buying multiple modules should be weighed against the cost of more-comprehensive packages.

IN SUMMARY Low-cost add-ons have always been attractive to *Lotus 1-2-3* users, and those for statistical analysis are no exception. These relatively inexpensive packages don't enable you to perform the depth of procedures that a high-priced standalone package does, but if you are familiar with *Lotus 1-2-3* and your needs are modest, one of these packages may be all you need.

—Frank M. Smith and Thomas A. Meyers

FACT FILE

***Forecast! for 1-2-3*, Version 2.1**
Intex Solutions Inc.
161 Highland Ave.
Needham, MA 02194
(617) 449-6222
List Price: $145
Requires: 384K RAM; two disk drives; DOS 2.0 or later; *Lotus 1-2-3*, Release 2.0 or later, or *Symphony* 1.2. Not copy protected.
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Abacus Scientific Software
4521 Campus Dr. #111
Irvine, CA 92715
(714) 786-6264

***Add a Stat*, Version 2.0**
List Price: $79.95
CIRCLE 679 ON READER SERVICE CARD

***Multifit*, Version 2.0**
List Price: $89.95
CIRCLE 677 ON READER SERVICE CARD

Required: 384K RAM; two disk drives; DOS 2.0 or later; *Lotus 1-2-3*, Release 1A or later. Not copy protected.

Stat-Packets
Walonick Associates, Inc.
6500 Nicollet Ave. South
Minneapolis, MN 55423
(612) 866-9022
(800) 328-4907
List Price: 23 analysis modules: data lister, frequencies, multiple response, crosstabs, banners, descriptive statistics, breakdown, t-test, correlation, linear & nonlinear regression, stepwise multiple regression, probit regression, principal components analysis, factor analysis, ANOVA, quality control (X-bar & R), exploratory data analysis, trend forecasting, seasonal forecasting, census X-11 decomposition, SABL robust decomposition, generalized adaptive filtering, and Box-Jenkins analysis, $24.95 each; 5 pre-packaged market bundles, or any combination of six different packets, $89.95 each.
Requires: 256K RAM; two disk drives; DOS 2.0 or later; *Lotus 1-2-3*, Release 1.0 or later, or *Symphony*. Not copy protected.
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permit seasonal variability to be highlighted and heteroscedasticity (changing variability of data over time) to be uncovered. One aspect of these plots we didn't like, however, is that the time plots are split across several screens. While this results in accurate plots, it makes it very hard to use the screen displays for viewing the data since the complete picture cannot be seen in a single display.

The plots can be printed or saved to a file. Serious forecasters generally want to compare a number of plots at once by printing them out and pinning them on the wall; *Forecast Plus* serves this need. Without a separate screen-capture program, you can send only low-resolution "printer plots" to the printer. It is not simple to plot two series on the same graph—necessary if forecasts and residuals are to be compared quickly.

Forecast Plus's data entry has some minor annoyances. In fact, in one test an accidental miskey caused the program to stop with an "Overflow" error message. The data entry part of any program should be robust to user errors. While the data entry program is not overly difficult to use, it isn't the *Lotus 1-2-3*–type of entry that the world is moving toward.

Data transformation could be improved by including more functions, such as percent change. In contrast, missing values are handled in a relatively sensible way, and the options for trading-day adjustments are quite rich.

Forecasters generally drop some of the recent data and try to see how well a method will "forecast" it. Such ex post facto forecasts and comparisons were not easily made in *Forecast Plus*, a weakness we consider quite severe in a package with otherwise strong forecasting features.

One of the major strengths of *Forecast Plus* is the choice of methods included. In particular, the inclusion of the SABL (seasonal adjustment–Bell Laboratories) "robust" seasonal decomposition method is useful as a counterpoint to the traditional Census X-11 decomposition, also included. However, the manual provides only a secondary reference to SABL, which uses running medians rather than moving averages as a mechanism for finding trends. SABL is an outgrowth of considerable statistical research into robust methods,

which work well despite contamination of data with *outliers*. It seems that it is necessary to carry out forecasts from decomposition models "manually."

We did not find mention of the Kalman filter methods that have begun to migrate from engineering to other fields of study. Nor are multivariate (multiple, simultaneous variables) forecasts possible. Nonlinear models, a subject dear to us personally, are also not treated.

The *Forecast Plus* manual provides a number of aids to the choice of methods, in particular, a table of methods entitled "Choosing an Appropriate Technique" and a "Technical Reference" to the methods. A good bibliography is included.

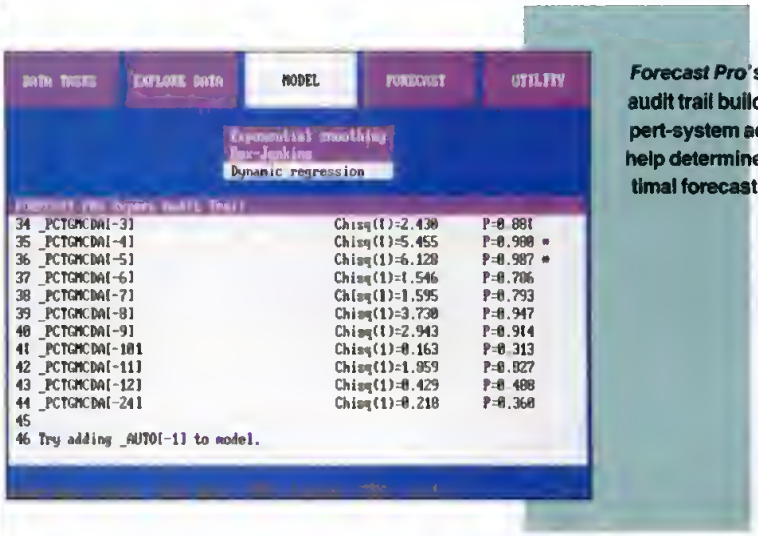
Forecast Plus features a batch processing mode with which the user can store a set of commands to be processed. This allows a series of analyses and forecasts to be prepared off-line. In the situation in which a user must prepare periodic updates to reports (of production or sales figures, for example) it is clear to us that this is the way to proceed. And the package processes data at an acceptable speed, even on a plain-vanilla PC.—**John C. Nash and Mary Walker-Smith**

Forecast Pro

What business forecaster wouldn't like to have master statisticians Robert Goodrich and Eric Stellwagen looking over his shoulder when running an important economic forecast? *Forecast Pro*, Version 1.10, doesn't include authors Goodrich and Stellwagen in the shrink-wrap of this $495 expert system, but you feel their presence.

The rule-based expert system guides you every step of the way through the complex world of advanced forecasting. It automatically chooses the best forecasting technique and recommends variable transformations to improve the forecast's accuracy. It skillfully uses pull-down menus to place you at the next logical menu selection throughout the process.

The authors chose the Schwarz criterion to determine the best model for your data but provide seven other criteria for judging the accuracy of the forecast. The intelligently designed expert system allows anyone to produce accurate forecasts and provides the expert statistician with the information and freedom to choose alternative forecasting models.



Forecast Pro's expert audit trail builds in expert-system advice to help determine the optimal forecast model.

Forecast Pro's techniques are a subset of those in *Forecast Master* (also written by Goodrich and Stellwagen). The methods selected for *Forecast Pro* were based on their usefulness to business forecasting. The algorithms and user interface were improved, a batch capability was added, and a rule-based expert system was developed.

The authors subscribe to the "Hemingway mode" of statistical analysis by stating " . . . for forecasting, simple is better unless there is sound evidence that a more complex approach will yield returns in forecast accuracy." Complex models provide a better fit to the historical data but are often poorer forecasting tools.

Based on this philosophy, *Forecast Pro* includes three carefully chosen statistical methods appropriate for business requirements: the Holt-Winter's family of exponential smoothing, Box-Jenkins (multiplicative seasonal model), and dynamic regression (for multivariate analysis).

Forecast Pro accomplished our forecasting task beautifully: it chose the method to be used and correctly recommended that an autoregression (with a lag of 1 time period) be used.

Entries to the audit trail are displayed after each stage of the forecasting process. These entries show the results of the regression analysis (mean, standard deviation, and others), judgment criteria for goodness of fit, and recommendations for further transformations. Data transformations recommended can include inverse, inverse square root, logarithm, and square root. Autoregression lags are recommended when indicated by the nature of your time-series data.

Forecast Pro's documentation has one section on its operations and two sections, tutorial and technical, that succinctly explain the complex statistical concepts and

FACT FILE

***Forecast Pro*, Version 1.10**
Business Forecast Systems Inc.
68 Leonard St.
Belmont, MA 02178
(617) 484-5050
List Price: $495 (academic and volume discounts available).
Requires: 512K RAM; CGA, EGA, VGA, or Hercules compatibility; DOS 2.0 or later. Math coprocessor strongly recommended.
In Short: A powerful forecasting package. *Forecast Pro* includes expert-system capability to guide the nonprofessional in making business forecasts. Supports the 8087, 80287, and 80387 coprocessors. Not copy protected.

CIRCLE 654 ON READER SERVICE CARD

A Day in Five Lives: Forecasting

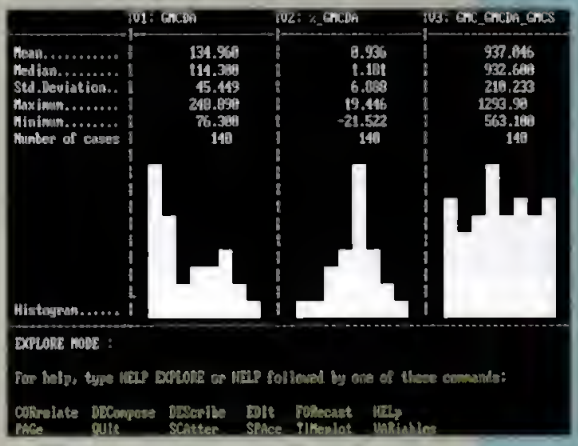
Task 4

This test used time-series analysis tools to forecast short-term economic indicators. Dedicated forecasting packages were tested in greater depth than this, but many of the general-purpose packages could perform this analysis with varying degrees of success.

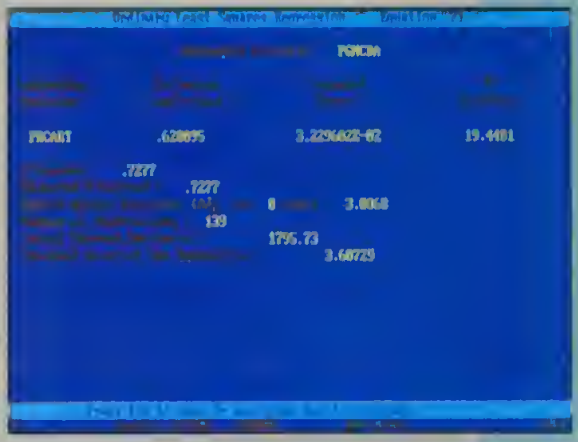
The reviewer tried to forecast consumer expenditures based on two related measures of consumption: general retail sales and car sales.

To analyze the data, we

- ran a regression on a time series—the percentage of change in monthly car-sales figures;
- ran a similar regression on a time series for the retail sales data;
- used an ARIMA (auto-regressive integrated moving average) technique to extract information from these two time series.



SmartForecasts II's Explore mode displays a histogram and the descriptive statistics for both measures of consumption—retail sales and car sales—and for forecasted personal consumption.



ESP uses a least squares regression model to forecast personal consumption.

techniques used to model your data.

Forecast Pro allows only one file format, a single time series in ASCII format. If your data is held in a database or spreadsheet, you must individually write each variable to a separate .PRN file. Time-series data must have a reference to time. You accomplish this by making a KEY file containing the calendar and a brief description of the variable.

When I was creating a lengthy formula for the percentage change in Retail Auto Sales for the forecasting task, the 60-character maximum sufficed to allow descriptive variable names.

To enhance your graphs to presentation quality, you must export your data via a metafile and import it into a program such as *Freelance* or *Manuscript*. The only control you have over your graphs within *Forecast Pro* is to change the title, the names of your variables (*x*- or *y*-axis labels), and the number of occurrences shown on one screen.

Forecast Pro is an effective forecasting tool that will save you time, improve the accuracy of your forecasts, and educate you on the nature of time-series data. *Forecast Pro* is a winning package.

—Robert C. Ullrich

MTS

As its name implies, *MTS* (*The Multiple Time Series Program*), $995 from Automatic Forecasting Systems, is de-

Forecasting: Summary of Features

(Products listed in ascending price order)

The eight forecasting packages we reviewed have several features in common. They all import and export ASCII files, and none import or export .DBF files. All perform linear regressions and compute correlation coefficients. In terms of forecasting, all can forecast directly from equations and can display the forecast versus actual results for comparison.

GENERAL PROGRAM FACILITIES	Pro*Cast $295	Autocast II $495	Forecast Pro $495	Foracast Master $595	Forecast Plus $595	Smart-Forecasts II $695	MTS $995	AutoBox Plus $1,195
Data import and export								
Imports/exports .DIF files	○ /○	○ /○	○ /○	○ /○	● ●	● ●	○ /○	● ●
Imports/exports Lotus 1-2-3 files	● ○	● ●	○ /○	○ /○	○ /○	● ●	○ /○	○ /○
Macro facility	○	○	●	○	●	○	○	○
Batch facility	○	●	●	○	●	●	○	●
Math coprocessor support	●	●	●	●	○	○	●	●
EGA support	●	●	●	●	○	○	○	●
Maximum number of observations	500	500	Unlimited	Unlimited	1,000	9,000	Unlimited	300
Maximum number of data points per file	6,000	500	50	Unlimited	30	150	Unlimited	6
Maximum number of variables	6,000	1	Unlimited	15	30	60	10	6
Weighting allowed	○	○	○	○	○	○	○	●
DATA MANIPULATION								
Data verification	●	○	●	○	●	●	○	○
Spreadsheet-type editor	○	●	○	○	○	●	○	○
Data transformations	●	●	●	●	●	●	○	●
Error trapping	○	○	●	●	●	●	●	●
Equations displayed	●	●	●	●	○	●	●	●
Equations saved and restored	○	●	●	●	●	○	●	●
STATISTICAL ANALYSIS								
Goodness-of-fit statistics								
Durbin-Watson	●	○	●	●	●	●	○	○
Chi-square	○	○	●	●	○	○	●	●
t-tests (univariate)	●	○	●	○	●	○	●	●
F tests	●	○	●	●	●	●	●	○
Likelihood ratios	○	●	●	●	○	●	○	○
Reliability testing	●	●	●	●	●	●	○	○
Regression								
Standard multiple	●	●	●	○	●	●	○	●
Nonlinear	○	●	○	●	○	●	●	○
Probit	○	●	○	○	○	○	○	○
Stepwise	○	○	●	●	○	○	○	●
Least squares	●	○	●	●	●	●	●	●
Restricted	○	○	○	○	○	○	●	○
Generalized	○	○	●	●	○	●	●	○
Nonlinear	○	○	○	○	●	●	●	●

—Editor's Choice ● —Yes ○ —No

	Pro*Cast $295	Autocast II $495	Forecast Pro $495	Forecast Master $595	Forecast Plus $595	Smart·Forecasts II $695	MTS $995	AstoBox Plus $1,195
STATISTICAL ANALYSIS								
Vector auto-regression	○	○	○	●	○	●	●	○
Time-series analysis								
Auto-correlation analysis	●	●	●	●	●	●	●	○
Cross-correlation analysis	○	○	●	●	○	●	●	○
Transforms (such as fast Fourier)	○	●	○	○	○	○	○	○
Data smoothing	●	●	●	●	●	●	○	●
Brown's	●	●	○	○	●	●	○	●
Quadratic	●	○	○	●	●	●	○	●
Holt-Wintars exponential	●	●	●	●	●	●	○	●
Forecasting								
Automatic model selection	●	●	●	●	○	●	●	●
Trend curve	●	●	●	●	●	●	○	●
Seasonal decomposition	●	●	●	●	●	●	○	○
ARMA, ARIMA modeling	●	○	●	●	●	○	●	●
Partial correlations	○	○	○	●	○	○	●	●
First-order serial correlations	○	●	●	●	●	○	●	●
Log-linear models	○	○	●	○	○	●	○	○
Cluster analysis	○	●	○	○	○	○	○	○
Multidimensional scaling	○	●	●	○	○	○	○	○
Spectral and cross-spectral analysis	○	●	○	○	○	○	○	○
Polynomial distributed lags	○	○	○	●	●	●	○	●
Transfer functions	○	○	●	●	○	○	●	●
Model simulation	○	●	○	●	○	○	○	●
DATA REPORTING								
Default report styles	●	●	●	●	●	●	●	●
Customized report styles	●	○	○	○	○	●	○	●
Publication-quality reports	○	○	○	○	○	○	○	●
GRAPHICS								
Bar and line graphs	●	●	●	●	●	●	○	●
Box and whisker plots	○	○	○	○	●	○	○	○
Histograms	○	○	●	○	●	●	○	○
Error bars	●	●	●	●	●	○	○	●
Scatterplots	●	●	○	○	●	●	○	○
Graphs can be edited	●	●	●	○	○	●	○	○
Multiple fonts supported	○	○	○	○	○	○	○	○
OUTPUT								
Laser printers	●	●	●	●	●	●	○	●
Plotters	○	○	●	●	○	○	○	○
Film recorders	○	○	●	○	○	○	○	○
Color printers	○	○	●	○	○	○	○	○
HELP AND DOCUMENTATION								
On-line help	●	○	●	●	○	●	●	●
Toll-free telephone support	○	○	○	○	●	○	○	○

PC MAGAZINE FACT FILE

***MTS*, Version 2.0**
Automatic Forecasting Systems Inc.
P.O. Box 563
Hatboro, PA 19040
(215) 675-0652
List Price: $995
Requires: 400K RAM, DOS 2.0 or later.
In Short: *MTS* offers vector ARIMA Box-Jenkins modeling and can construct both vector (more than one variable) and univariate (only one variable) models. The program can identify, estimate, and forecast the model starting with only the time-series data points, the periodicity, and the stationarity conditions. *MTS* supports Box-Jenkins model identification and diagnostic checking and has some data-management capability. Not copy protected.

CIRCLE 653 ON READER SERVICE CARD

signed for one specific set of tasks—to identify, estimate, and forecast both univariate (one variable) and multivariate (more than one variable) time series. And it can provide very accurate forecasts in a very short time.

MTS, Version 2.0, represents a significant advancement in technique over traditional estimation, and it handles the most difficult aspects of time-series modeling—estimation and forecasting—quite efficiently. A very streamlined package with few creature comforts, *MTS* is a powerful program for certain situations, but it does not provide enough versatility to satisfy the requirements for a useful time-series package.

The program employs a very quick algorithm: for a typical univariate time series with 30 observations, *MTS* requires about 1/1000 of the calculations required by typical estimation methods and manages to preserve accuracy as well. Forecast estimates using *MTS* are not significantly different from traditional methods.

The problem with the program is that it's too streamlined. Time-series analysis requires very strong restrictions on the statistics (mean and variance) of a variable. *MTS* provides only limited facilities; the program essentially assumes it is working with data that already meets the requirements of well-behaved time series. This lack of data-handling and -editing features seriously diminishes the role of *MTS* in overall time-series estimation.

One strength of *MTS* is the automatic identification, estimation, and forecasting mode it offers, which produces models and forecasts from raw data with no input (beyond data entry) from the user. Time-series analysis, with all of its "rocket science" equations, is still much more of an art than a science. Automatic analysis is thus a very powerful feature, making *MTS* accessible to a much wider range of skill levels. The resultant models are both a pedagogical guide for novices and an objective double-check for the more experienced.

There is, however, a serious failing in the easy use of *MTS*'s automatic forecasting methods. Little mention is made of the shortcomings of using time-series methods for certain data. Concerns over stationarity, seasonality, and degrees of freedom are not given enough mention, while a few statistics useful for time-series analysis are not presented at all. Although most packages suffer from this deficiency, the danger is multiplied in a package that separates users from the actual process. Finally, the documentation is sketchy, especially with respect to the exact criterion used in the automatic estimation and forecasting methods.

A very streamlined package with few creature comforts, *MTS* is a powerful package for certain situations.

Although the installation of *MTS* is straightforward, the documentation is not totally accurate. One glaring example: chapter 4 of the manual instructs the user to type the command "*MTS*": don't, the file doesn't exist! Only after some examination did I find the right command. Errors such as this can prove to be extremely frustrating.

In its present state, *MTS* is more of a "program" and less of a "package." Data transformation and manipulation techniques, full-screen editing and graphics capabilities, and descriptive statistics routines would aid greatly in the overall usefulness of the program. According to Automatic Forecasting Systems, these functions are in the works.

—John R. Connelly

Pro*Cast

*Pro*Cast*, $295 from Fleming Software, is an easy-to-use forecasting package. A clearly laid-out set of pop-down menus and well-designed graphic screens keep the user interface clean and clear. *Pro*Cast*, Version 2.2, can be used in automatic mode but has only a limited set of tools.

Data handling in *Pro*Cast* is based on one time series per data file. This simple mechanism is relatively straightforward to use, though it can generate a lot of series (and a lot of data files) quite quickly if you wish to save models, residuals, and forecasts from several methods. Heavy use of the program might easily cause directory overflow troubles.

When files with blank lines at the bottom are imported by *Pro*Cast*, the program generates seemingly random entries in time series. This is obviously a danger to be avoided. Data export is quite flexible, allowing multiple variables in a file. However, you cannot then import files exported from the program. Also, missing values and trading-day adjustments are not handled—a serious deficiency for real problems.

The weakness of *Pro*Cast* is that it does not include enough tools, especially for data exploration. The program doesn't offer a seasonal decomposition method in

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The Box-Jenkins model is one variation of the ARIMA forecasting technique. *Pro*Cast* displays a graph indicating the time-series data, the forecasted trend, and the confidence interval.

the usual sense. Instead, *Pro*Cast* always decomposes seasonal series. A data series is deseasonalized by computing multiplicative seasonal factors. The deseasonalized series is then forecast by use of various trend methods or ARIMA models. However, the Box-Jenkins ARIMA modeling provides for only nonseasonal models of the deseasonalized series, despite the fact that seasonal ARIMA models are straightforward (if tedious) to work with and in many cases are the model of choice for seasonal data.

The documentation for the product is clear for those new to forecasting and PCs. The product provides both on-line help and an on-line tutorial, as well as a helpful tutorial in the documentation.

The package presents a useful summary table of the best six forecasts generated during a session. *Pro*Cast* displays its graphics on a single screen and supports EGA, Hercules, and CGA standards. We liked the EGA displays, but the default color selection was rather unpleasant. Fortunately, it's easy to change the program's colors.

It isn't possible to save plots to a file within *Pro*Cast*. The range of graphics is more limited than in *Forecast Plus*, but the user can provide simple "line-by-eye" additions to the graphs for simple judgmental forecasting. The program also includes facilities for comparative plots.

*Pro*Cast* lets you choose the accuracy of the calculations you wish it to perform. We found that the operational speed of the program was not seriously affected by increasing the degree of accuracy and is adequate in all modes.—**John C. Nash and Mary Walker-Smith**

FACT FILE

***Pro*Cast*, Version 2.2**
Fleming Software
P.O. Box 528
Oakton, VA 22124
(703) 591-6451
List Price: $295
Requires: 512K RAM; CGA, EGA, VGA, or Hercules compatibility; DOS 2.0 or later.
In Short: *Pro*Cast* is an easy-to-use forecasting package. While its capabilities are limited, it can provide unsophisticated users with a fairly safe and reliable tool for making reasonable forecasts of single data series. Not copy protected.

CIRCLE 652 ON READER SERVICE CARD

SmartForecasts II

Are you smart enough to select the correct forecasting technique to use with your business data, or would you prefer that a smart program choose for you? Recommended for the novice or intermediate business user who doesn't want to have to learn the jargon and theory of advanced statistics, *SmartForecasts II*, $695 from Smart Software, is a fast, easy-to-use package that provides sufficiently accurate forecasts. It'll even make some difficult choices for you.

SmartForecasts II, Version 2.15, features an Automatic command that conducts a tournament among five forecasting techniques (single exponential smoothing, simple moving average, double exponential smoothing, linear moving average, and Winter's exponential smoothing), chooses the most accurate method based on the nature of your data, and then suggests a maximum number of periods you may accurately forecast. The program is flexible enough to allow advanced users to choose any preferred forecasting method, though it has a few flaws that limit its usefulness as a tool for advanced statistical forecasting.

Everything about *SmartForecasts II* was designed to facilitate its use. A fine tutorial is provided to familiarize you with the program. Although the product is command driven, the commands for each major mode are always displayed on the lower part of the screen, and all of the mnemonically named commands can be abbreviated. It's difficult to forget the "Oops" command once you learn it will

FACT FILE

***SmartForecasts II*, Version 2.15**
Smart Software Inc.
392 Concord Ave.
Belmont, MA 02178
(617) 489-2743
List Price: $695; Batch (supports unlimited number of variables), $6,000; LaserControl (supports HP LaserJet and HP DeskJet), $149; Mode MGA (supports Hercules monographics), $79.
Requires: 256K RAM; CGA, EGA, VGA, or Hercules compatibility; DOS 2.0 or later.
In Short: A simplified forecasting package that has a fast automatic mode for single variable forecasts, *SmartForecasts II* is easy to use and doesn't require a professional forecasting background. No coprocessor support. Not copy protected.

CIRCLE 651 ON READER SERVICE CARD

undo your last Edit command. And the Eyeball command lets you modify graphical forecasts interactively. Help screens for each command are available at the main menu for each of the three major modes: Edit, Explore, and Forecast.

The well-written, professionally designed documentation and on-line help messages use appropriate business examples and standard English to explain the program. Complex technical terms are not defined with equally complex language; for example, *independent* variables are not referred to as *exogenous* variables.

For your convenience, *SmartForecasts II* reads and writes files in a wide variety of formats. Its own SFII worksheet format provides much faster file load and save times for your latest data. It is, however, limited to reading data from one file at a time; you cannot combine data from multiple spreadsheets or output files.

The program's standard configuration allows 60 variables with 150 occurrences each for a total of 9,000 data points. Using this configuration, you can enter 10 years of monthly historical data and still have enough space for 30 months of forecasts. You may purchase the program in two optional configurations: 45 variables by 190 occurrences or 25 by 300. A $6,000 batch option allows simultaneous forecasting of thousands (limited by hard disk capacity) of variables of 150, 190, or 300 occurrences each.

COLORFUL GRAPHS The colorful graphs may be annotated with text anywhere on the display (even over the data). Using a special key combination (Ctrl-PrtSc), you can print the graph on your dot matrix printer. *SmartForecasts II* does not support a metafile format that would allow export of the graphs to more-powerful graphics packages.

If you require more control over the publication quality of your forecasts, you may save the forecasts within the worksheet and export them to your favorite spreadsheet or word processor.

For multivariate regressions, *SmartForecasts II* does not automatically recommend leading indicators or data transformations (differentials, autoregression, square root, logarithm, percentage change) that often improve the accuracy of your forecasts. The correlate function can, however, be used to tell you some of the information you need to make these judgments. Most users of *SmartForecasts II*, such as marketing managers, manufacturers, and economists, will obtain valid predictions without employing advanced statistical techniques.

In the forecasting task, *SmartForecasts II* performed the regression but could not perform the advanced Box-Jenkins technique (autoregressive integrated moving average). In fairness to *SmartForecasts II*, the Box-Jenkins technique is useful only when the history is reasonably long and may not be necessary for the typical requirements of nonstatisticians.

One small complaint: *SmartForecasts II* has an unusual and annoying habit of sending a printer reset code when starting up, which aborts any print job in progress.—**Robert C. Ullrich**

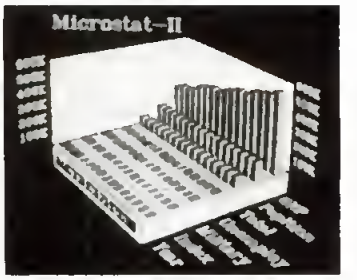
PC MAGAZINE EDITOR'S CHOICE

- **Forecast Pro**

When we last reviewed business forecasting packages (August 1986) we chose 1,2,3 Forecast!, SmartForecasts II *and* Forecast Master *as our Editor's choices. These products continue to do a good job*—SmartForecasts II *and* Forecast! 1-2-3 *(the latest incarnation of* 1,2,3 Forecast!*) continue to be easy to use and give accurate forecasts.* Forecast Master *has had no major changes since September 1986, but its author, Robert Goodrich, has teamed up with Eric Stellwagen to create* Forecast Pro.

Forecast Pro *combines* Forecast Master*'s advanced statistical technique with an expert system that can guide both the novice and the advanced user to optimal forecasts. It has a keen technological bent, but the expert system provides such excellent guidance that complete understanding of complex statistical theories is not necessary.*

MICROSTAT-II
Release 2.0



Now you can use Microstat-II with your favorite graphics package, such as Three D Graphics, Harvard Graphics, Microsoft's Chart, Grapher, and others to give your statistics a new dimension. A few quick keystrokes and Microstat-II writes out a file that can be read into your graphics package for any refinements you might want to make.

Just some of the features in Microstat-II Rel. 2.0 include:

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- Orthogonal Factors
- Regression Analysis (multiple and Stepwise)
- Nonparametrics
- ANOVAs
- Crosstabs and Chi-Square
- Time Series
- Descriptive Statistics
- Frequency and Probability Distributions
- Hypothesis Tests (mean and proportion)
- Data Management system with full-screen editing
- Easy to use: no complex command language to learn

Best of all, the price is still $395.00. (Previous owners of Microstat-II should also call for free update offer.) For more information, call or write:

Ecosoft Inc.
6413 N. College Ave.
Indianapolis, IN 46220
Orders: 1-800-952-0472
Tech. Info: 1-317-255-6476
FAX: 1-317-251-4604

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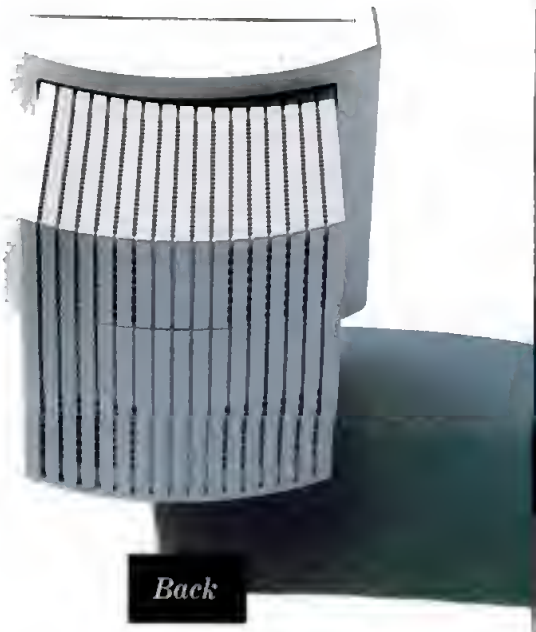
ECOSOFT

Some views on why the NEC MultiSync

There's a lot more to the new MultiSync® 3D monitor from NEC than meets the eye. Because instead of making one monitor for each graphics board, we've developed a monitor that enhances the performance of the modes on practically *any* board.



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What's more, MultiSync 3D is equally compatible with you and your workplace. There are upfront controls, for easier access. A 14" non-glare screen on a tilt-swivel base, for more comfortable viewing. And, as you can see, there's even a full 360 degree design.

The way we see it, MultiSync 3D

Side

Top

has dramatically raised the standards by which all other color monitors will be judged.

MultiSync is a registered trademark of NEC Home Electronics (USA) Inc

For literature, call 1-800-826-2255. For technical details call NEC Home Electronics (USA) Inc. 1-800-FONE-NEC.

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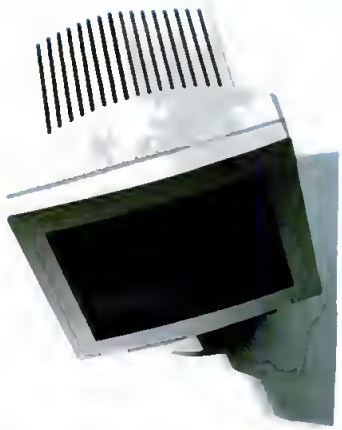
NEC

We make a super VGA monitor



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MultiSync 2A. One super VGA monitor.

VGA mode shown at 320 x 200

C&C
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that's also a SuperVGA monitor.

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MultiSync is a registered trademark of NEC Home Electronics (USA) Inc

MultiSync 2A. One SuperVGA monitor.

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NEC

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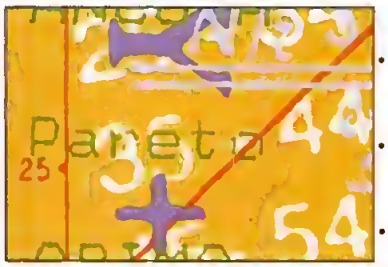


SPECIAL INTEREST

Not everyone needs, or wants, a statistical package with the full complement of statistical analyses. For some, a package dedicated to one field of endeavor may be the appropriate solution to their data analysis needs.

In this section we look at five single-purpose packages: *A-Cross*, a package that does stub and banner cross-tabulation; *NWA Quality Analyst*, a statistical quality control package; *QA/S*, a quality assurance (or process control) package; and two packages designed to handle survey data: *SL-Micro* and *SumQuest*.

A-Cross

While *A-Cross*, $995 from Strawberry Software, may be only a cross-tabulation package, it does cross-tabs with more ease, speed, and flexibility than almost any other piece of software currently available. *A-Cross*, Version 2.00, enables you to know things such as the percentage of football-playing males under age 18 who will buy your product and to see this cell of a multiway table quickly, without issuing complicated commands.

With *A-Cross* it is easy to specify a table's contents using the spreadsheet format and fill-in-the-blank windows. The runtime version of *DESQview* multitasking software that comes with *A-Cross* allows simultaneous computing and printing, which speeds up analyses. Almost any combination of stub and banner points, cell contents, marginal averages, and weighting of cases that a market researcher could ever want can be included in a single table. Unfortunately, the market survey analysis task included in this review did not afford the opportunity to show off these qualities of the program.

Professional market researchers and survey analysts will not only find *A-Cross*'s speed and flexibility appealing, but they will appreciate the availability of runtime modules of the software, as well. These modules allow a consultant to set up a copy of the software with preformatted banners and stubs for a specific data set that the client can use to produce additional tables.

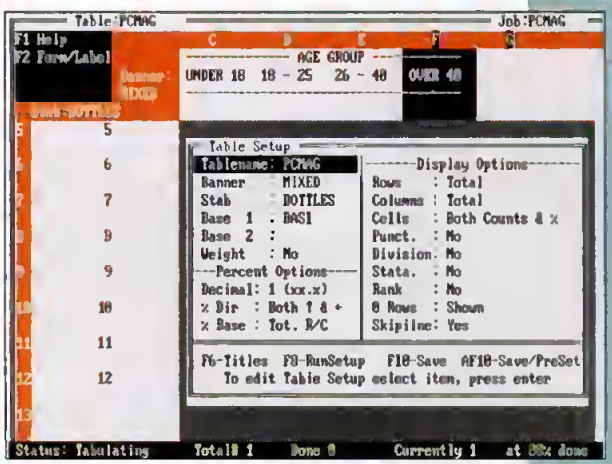
Two features simplify table setup and help keep track of analyses of a large survey. A Data Glossary handles shorthand definitions of the variable locations and values in the data file. This simplifies the specification of the formulas indicating the observations for each stub and banner point. A Notes utility has been included for keeping on-line notes about the data set being analyzed. Thirty multiscreen notes can be linked with the tables to furnish site-specific on-line help, annotate assumptions about tables or data subsets, or indicate the wording of questions and answers.

PC MAGAZINE FACT FILE

A-Cross,
Version 2.00
Strawberry Software
Inc.
42 Pleasant St.
Watertown, MA 02172
(617) 923-8800
List Price: $995 (includes runtime version of *DESQview*).
Requires: 512K RAM, hard disk, DOS 2.0 or later.
In Short: *A-Cross* is a wonderful tool for a small niche of users interested in performing cross-tabulations on survey data. Written in the C language, it has the best tabling facilities of any PC package and is fast. Tabling is all that it does, however. Analysts will most likely need an additional package because *A-Cross* lacks data management capabilities and has limited statistical functionality. Not copy protected.

CIRCLE 699 ON READER SERVICE CARD

One drawback of the package (which will be addressed in the next version) is the complete lack of data management facilities. The data validation steps in the market survey analysis task were accomplished indirectly, through the combined use of the program's Marginals utility—a subprogram for screening typographic errors—and table filtering capabilities. To offset this limitation, Strawberry Software currently comarkets *MPA*, a separate data-



A-Cross, designed specifically to perform cross-tabs, makes it particularly easy to view the contents of a single cell in the cross-tab. Here, the program is setting up a stub-and-banner table.

entry product not included for this review.

A-Cross is not a statistics package per se, although the newest version does include chi-square computation. Some summary statistics can be supplied for cells, but not expected frequencies or each cell's contribution to the chi-square. T-tests can be computed for any pair of columns by weighting counts by the value. The user must ensure that the choice of columns and rows makes sense for such analyses; the manual does not provide help or advice for making such choices.

Designed for a small niche of analysts, *A-Cross* is a tool that must be used in conjunction with other tools. Most people who would benefit from a package such as *A-Cross* won't mind its statistics shortcomings. They will appreciate the quick answers to most questions that arise about survey data.—**Minna Levine**

FACT FILE

***NWA Quality Analyst*, Version 3.12**
Northwest Analytical Inc.
520 NW Davis St.
Portland, OR 97209
(503) 224-7727
List Price: $495; BASIC source code, additional $75; Network version, $2,500.
Requires: 512K RAM, DOS 2.0 or later. Certain routines require CGA, EGA, or Hercules compatibility.
In Short: *NWA Quality Analyst* is a library of compiled BASIC programs with an overlying menu structure designed specifically for quality engineers and statistical process control people. Not copy protected.

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NWA Quality Analyst

NWA Quality Analyst, Version 3.12, is manufactured by Northwest Analytical, the same company that is responsible for *NWA Statpak*. (*NWA Statpak* is reviewed in the "Statistical Analysis: Basic" portion of this article.) Many similarities exist between the two packages: both are libraries of compiled BASIC programs with an overlying menu structure; both use the same file format. Many other features are identical in either package, including data import and export, file editing, and graphing routines.

What's different about *Quality Analyst*, $495, is that here many of the routines found in *Statpak* have been dropped in favor of new routines that cater specifically to the needs of quality control engineers and statistical process control people. *Quality Analyst* produces beautiful histograms and control charts of the type often used in factories. It also has a batch-run utility that can allow the user to automate certain repetitive chart-making functions.

One advantage of *Quality Analyst* over *Statpak* is the large number of variable types it can accept. Measurements can be made, for example, with five sample data points recorded for each lot number. Or data can be entered in "reduced" form, indicating only the mean, the range, and the standard deviation of a group of measurements. Another data type is "grouped data," in which a data value is entered along with a multiplier, indicating how many times that data value was observed.

As with *Statpak*, missing or comma-delimited data can create problems for *Quality Analyst*. And some of the statistical functions supported by *Statpak* but dropped in *Quality Analyst*—particularly nonparametric and two-way ANOVA (analysis of variance) functions—made *Quality Analyst* a poor performer in many of our tests. But the quality control engineering task enabled *Quality Analyst* to shine in that specific area.

The package created frequency-distribution histograms, X-bar and R control charts, and Pareto analysis graphs with almost no effort. In fact, the sample engineering task data did not thoroughly test this product's limits for analyzing typical quality control data. Furthermore, as quality control information tends to come from mechanical sources (as opposed to human sources, such as in the market survey task or the social science analysis task), it is rare to have missing or invalid data, making the data importation problems less of a concern for *Quality Analyst*.

It is worth noting that *Quality Analyst* can import data in DataMyte format. DataMyte is a respected vendor of data collection equipment (see the sidebar "Before Statistics There Must Be Data: Data Collection Techniques"). There are also specific instructions for interfacing *Quality Analyst* with *Labtech Notebook*, a data acquisition software product.

NWA Quality Analyst is a statistical analysis product that deserves strong consideration by users—particularly those in manufacturing—who specifically need quality control statistical functions. Other disciplines will find the product of less use. *Quality Analyst* has an old-fashioned, line-oriented user interface, but the package nonetheless produces attractive and useful graphs.—**Martin L. Ramsay**

QA/S

Quality assurance has become the operative of primary concern for organizations ranging from the largest automobile manufacturers to your local community hospital's laboratory. And it is the sole reason for the existence of Paul Hertzler & Co.'s $1,795 *QA/S*, a single-purpose statistical software package that makes no pretense of suitability for tasks other than quality assurance.

Unlike conventional quality control practices, quality assurance (also referred to on the factory floor as statistical process control) attempts to locate trends and correct them long before parts are manufactured outside of control limits. For this purpose, *QA/S*, Version 3.20, is indeed a powerhouse.

Three basic methods exist for importing information into the *QA/S* database, and the choice will largely boil down to the size of your plant and the initial expenditure you're willing to make.

The first, most practical, and most expensive method (at least in the short term) is automated data entry from electronic data collection instruments, such as digital micrometers. Through the use of optional GagePorts, as many as 32 instruments can feed their measurements into a PC through a single RS-232 serial port, and the operation should be particularly attractive with

BEFORE STATISTICS THERE MUST BE DATA: DATA COLLECTION TECHNIQUES

What do the Federal Express truck driver, the supermarket checkout clerk, the *Wall Street Journal* pollster, and the wildlife biologist who counts elk in Montana have in common? They all collect data that will later be analyzed statistically. If it weren't for the initial act of collection, there wouldn't be data to analyze or the need for statistics.

Data collection techniques cover a broad range of technical sophistication. One of the simplest ways to collect data requires only a person armed with paper and a pencil. Once gathered, data collected in this manner could be entered into a computer and analyzed. But studies have shown that the process of hand-keying data is associated with an error rate of 11.6 percent. And hand-keyed data is available for analysis only long after it is actually collected. Technology has given us more-efficient and more-accurate techniques for collecting information.

One popular method is bar coding. We've all seen the black bars on the back of a cereal box (or the lower-left corner of this magazine's cover); they can be read by an optical scanning device, usually a laser. The checkout clerk at the supermarket uses the universal product code (UPC) on each item you purchase to determine the amount you owe. That collected information is also used to analyze the store's inventory levels and buying patterns.

Federal Express employees use bar coding to record a package number and other information when your parcel is picked up. The information is beamed to Federal Express's central computer immediately—the status of your package is always current.

Videx (1105 NE Circle Blvd., Corvallis, OR 97330; (503) 758-0521) is just one company that makes an inexpensive bar code reader designed to work with IBM PCs and compatibles. Videx's 8K TimeWand sells for $248 and is the size of a thick credit card. The TimeWand, Videx's $149 Recharger, (which "harvests" data out of the TimeWand), and the right communications software are all that's necessary to get into the bar-code-reading business. That is, as long as the data you're aiming to collect has bar codes on it or can easily have a bar code label attached to it.

On the factory floor, where instant access to information is critical, direct data-entry devices are gaining in popularity. DataMyte Corp. (14960 Industrial Rd., Minnetonka, MN 55345; (612) 935-7704) has long been recognized as a leader in providing such devices for factory applications. Using electronic measuring gauges, DataMyte's products provide real-time information about the process being measured. This is useful for quality-control applications; some of DataMyte's devices can generate up-to-the-minute control charts on a monitor.

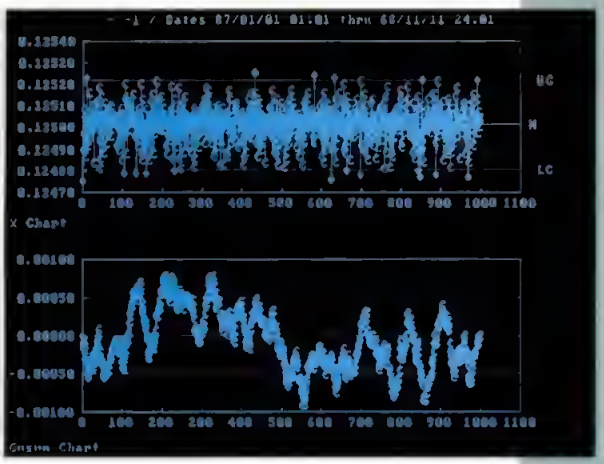
Technology has given us more-accurate means for collecting data.

If your needs incline less toward gauge measurement and more toward instrumentation, Laboratory Technologies Corp. (400 Research Dr., Wilmington, MA 01887; (508) 657-5400) has a software product that takes the hassle out of interfacing statistical analysis software with the data-acquisition hardware that takes laboratory measurements. *Labtech Notebook* drives many PC interface devices and creates data files that a variety of statistical packages can use. It can be programmed to collect data at certain times, when certain events occur, at certain rates, and so on. Laboratory Technologies' Fred Putnam tells of a hospital that employs *Labtech Notebook* to study the progress of premature babies and the events leading to sudden infant death syndrome (SIDS). *Labtech Notebook* records information such as the baby's breathing patterns for analysis.

Another high-tech data-collection option is voice data entry. Voice recognition devices have become more sophisticated since *PC Magazine* last looked at them (see "Voice Recognition: Understanding the Master's Voice," *PC Magazine*, October 27, 1987). The Voice Connection (17835 Skypark Circle, Suite C, Irvine, CA 92714; (714) 261-2366) has a product called the PTVC-756 Voice Data Logger that includes a headset hooked to a small box worn on a belt. The user speaks into the headset, and the signal is transmitted to a receiver hooked into a PC. Software on the PC is "trained" to understand the user's particular way of speaking, so that the user has a real-time, hands-free way of collecting data.

Common voice-data-entry applications are quality control in factories and on shipping and receiving docks, where the user verbally describes to the computer the items being transported.

If you need remote data entry but don't require the complexities of voice data entry, LXE (303 Research Dr., #144, Norcross, GA 30092-2993; (404) 447-4224) makes radio-transmission data-entry devices that will support bar code readers, keyboards, and other input devices.—**Martin L. Ramsay**



QA/S can plot a histogram with as many as 1,000 data points, as shown in the upper graph. The lower graph shows a cumulative summary of variance, helpful in indicating trends.

the network version of *QA/S*. Although the initial cash outlay for such an installation would be formidable, it would eventually lead to a labor cost savings.

Smaller shops will likely opt for manual data entry, and for this, *QA/S* is equipped with a menu-driven user interface and rather friendly data-entry screens. Options can be selected by using either the function keys or by highlighting labels along the bottom of the screen. In addition, the Shop Floor Sub-system, an optional module designed just for manual data entry for small shops with clusters of PCs, is available separately at a much lower price ($195).

The final alternative is to import data from another source capable of generating an ASCII text file that conforms to its rigid data records, and while the task can be accomplished, its speed is on a par with slow-motion photography of a three-toed sloth taking a nap. Importing a data set of 1,000 records from a *Lotus 1-2-3* spreadsheet (in .PRN format) took an agonizing 55 minutes. In contrast, at least one general-purpose statistical analysis program accomplished the same task on the one variable in question (and ignoring the other nine requisite fields in a *QA/S* record) in a scant 5 seconds.

Once data has been entered into the *QA/S* database (and consequently indexed), however, it can be retrieved quite quickly. Gathering up those same 1,000 records takes but a few seconds from the hard disk of an AT-class machine.

Furthermore, the B-tree construction of the index files makes record selection quick, regardless of which field (such as part number, date, lot number, operator, and so on) is selected. Add to this a keystroke-recording macro facility, and analysis charts can be called up in quick order.

Once a data set has been rounded up, *QA/S* supplies a broad range of charting and reporting options such as histograms, trend analyses, scatter diagrams, operation characteristic curves, and Pareto charts. These can be displayed in high-resolution graphics mode at CGA, EGA, or VGA resolution limits (depending on the video adapter in use). They can also be printed on Epson-, IBM-, or Okidata-compatible printers, or plotted on any Hewlett-Packard Graphics Language–compatible plotter. Through setup options, the colors of any lines, titles, control limits, and the like can be selected.

Installation of the package onto a hard disk is handled painlessly, thanks to the use of a batch file. From there, however, be prepared to spend a substantial amount of time with the rather intimidating manual. Remember, *QA/S* is targeted at the engineering staff and assumes that you are already well-versed in statistics and process control.

If statistical process control is your primary consideration, *QA/S* may be one of the best choices available.—**Frank Bican**

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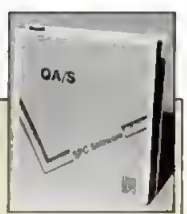

***QA/S*, Version 3.20**
Paul Hertzler & Co. Inc.
221 N. Main St., #300
Goshen, IN 46526
(219) 533-0571
List Price: $1,795 for full system (including QA/S Core, QA/S Variables, and QA/S Attributes); QA/S Core (variable data; manual entry only), $595; QA/S Variables, $995; QA/S Attributes, $995; QA/S Net (network version), $4,500.
Requires: 640K RAM; hard disk; DOS 2.0 or later; CGA, EGA, VGA, or Hercules graphics adapter.
In Short: Written in Pascal, *QA/S* is a powerful statistical process control tool designed specifically for the factory quality assurance engineer. Not copy protected.

CIRCLE 697 ON READER SERVICE CARD

SL-Micro

Designed primarily for use as a survey analysis tool, Questionnaire Service Co.'s *SL-Micro*, Version 2.16, is raw but so straightforward that it achieves a certain simplicity of operation. For schools, foundations, and small businesses on a budget, *SL-Micro*, priced at $250, is a good value. It offers meaningful interpretations of survey data and, once learned, is easy to use. *SL-Micro*, is not recommended, however, for engineers and scientists who will require statistical capabilities beyond this program's intended limits.

If graphical user interfaces, "user-friendly" menus, and icon-oriented applications leave you yearning to roll up your sleeves and do some real computing, you'll find *SL-Micro* appealing. On the other hand, if you're uninspired by a blank screen and a C> prompt, then stick with the slicker packages to do your statistical analyses.

Because it is really nothing more than a batch command language, *SL-Micro* requires you to write code to ASCII files using the text editor of your choice. After the code is written, you must instruct the program to process the statements relative to

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CIRCLE 382 ON READER SERVICE CARD

A Day in Five Lives: Quality-Control Engineering

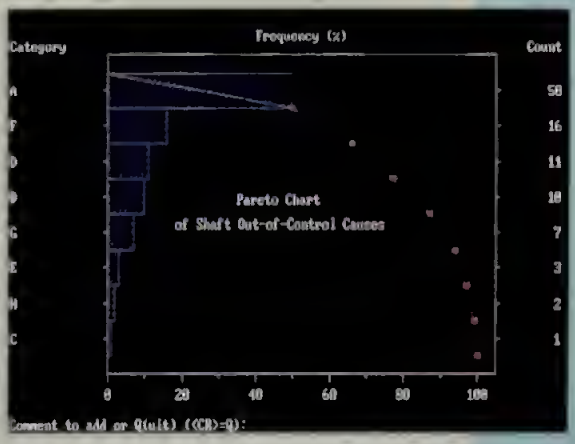
Task 5

We chose a quality-control task set in a factory that manufactures a small electrical motor shaft. The reviewer needed to determine how tight a tolerance for error could be expected on the screw machine lathe that produces the shaft.

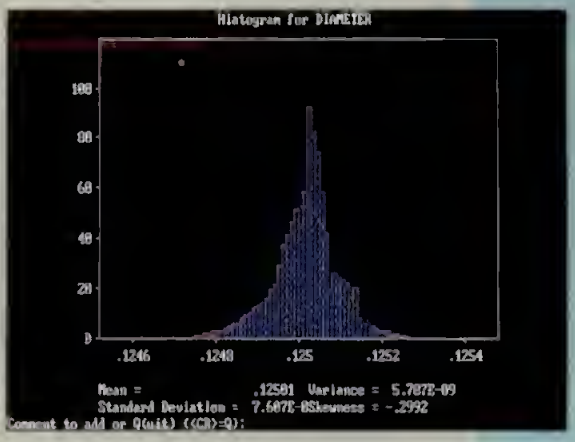
Each reviewer received three data files. The first contained 1,000 sample motor shaft diameters. The second contained 40 periodic output samplings from the lathe, as well as the time of day the sample was solicited (to monitor potential quality-control problems). The third data set contained 100 records of single-digit codes for out-of-control conditions.

To analyze the data, we

- displayed a histogram and performed descriptive statistics (mean, standard deviation, and normalcy of the distribution) on the first data set;
- imported the second data set so that the two fields—time of day and diameter of shaft—were acceptably entered;
- created a control chart to observe how the package graphed a trend;
- created a Pareto chart (a sorted histogram) based on the coded information in the final data file;
- enhanced and annotated the charts.



The Pareto chart produced by the *NWA Quality Analyst* shows the results of analyzing the data for the most frequent cause of shaft problems. Note the cumulative percentage curve superimposed on the histogram bars.



This graph of the histogram data for the quality-control engineering task was created by *NWA Statpak*. The red line is a superimposed normal curve over the actual histogram data.

the field positions of your data file. Because it is command driven, strict rules must be adhered to: commands can be typed only in capital letters, and command text must be begun in column 16. The program doesn't supply friendly error messages when you do something wrong—you just get no results. Users accustomed to programming in database languages or earlier versions of *SPSS* will have no trouble adapting to the rigid and unforgiving process. But some less-sophisticated users may not find learning the $250 program's proprietary syntax worth the investment.

SL-Micro is raw but direct, with a certain ease of operation.

For data entry, *SL-Micro* contains an on-screen facility to input survey results or cases. This module slightly automates the data entry process by prompting the user for the next response, and it allows for updates to each case when follow-up surveys are performed. Using this module for data entry offers protection in achieving valid responses. You can program the module to allow only fields of the correct length and data within defined ranges or specific alpha characters.

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CIRCLE 165 ON READER SERVICE CARD

PC MAGAZINE FACT FILE

***SL-Micro*,**
Version 2.16
Questionnaire
Service Co.
P. O. Box 778
East Lansing, MI 48826
(517) 641-4428
List Price: $250
Requires: 256K RAM, hard disk recommended, DOS 2.0 or later.
In Short: This is not a point-and-click or even a fill-in-the-blank application. *SL-Micro* is written in compiled BASIC and is a command language in which statements written to ASCII files are then processed by the program. The results are then written to ASCII files. The package is best suited for analysis of survey data and users proficient with their computer's operating system. Not copy protected.

CIRCLE 696 ON READER SERVICE CARD

It is possible to bring outside ASCII data into the data entry module, where it can be viewed and updated on a case-by-case basis. But this process requires more complicated programming. Most users importing data will find it easier to establish field-length records and identify variables in the command setup files, and then instruct *SL-Micro* to merely look up the designated data file (as was done in all our tests). Needless to say, imported data files may require extensive editing prior to use.

SL-Micro will process up to 32,600 cases with 200 variables. Two- and three-way cross-tabulations, five-way breakdowns, and basic statistics including simple regressions are its strengths. Histograms can also be generated. These graphic expressions are crude at best: generated by the DOS print command so that they can be produced on nearly any printer, they use dashes, concatenates, and asterisks to create the displays. But they are meaningful, and ultimately that's what counts.

By dispensing with a user interface, *SL-Micro* has kept its program small. The entire language fits on a single 360K floppy disk and will run in a tiny 128K RAM. To install the program, simply copy its one diskette onto a hard disk-drive. With a separate diskette for data, it could even be used on a two-disk-drive system—no complicated I/O choices here. Outside of a status line during program processing, no results are written to the screen, so it supports any monitor.—**Stephen Lewiski**

SumQuest

SumQuest, $595 from SumQuest Software, could be the perfect software for the do-it-yourself survey taker. It has all the basics needed to make creating a questionnaire and analyzing its results easy. Version 3.0 also has some very annoying quirks, however.

SumQuest is designed to allow anyone, no matter how knowledgeable or ignorant of statistical and survey methods, to conduct a useful and correctly designed survey. It has everything you need, including a well-written manual that contains clear instructions and a concise tutorial on how to design, conduct, and analyze different types of surveys.

Preparing questionnaire files for analysis is a straightforward process but is restricted by the *SumQuest*'s file format requirements.

Questionnaires are limited to a maximum of 250 questions with no more than 16 possible answers for each (not including the "no response/does not know" category). Questionnaires longer than 250 questions can be split in half and the answers cross-tabulated in a separate process.

SumQuest's built-in editor gives you all the functions you need to manage your data. You can view, change, add to, and delete from previously created files. The editor prevents bad data from creeping into the questionnaire by allowing input of only the responses identified when the questionnaire was set up. Unfortunately, there is no error-checking feature for files imported into *SumQuest*.

Only ASCII files created in a *SumQuest* format can be imported, and they must be run through a separate conversion program. The process is tedious, and the manual's instructions for this procedure are obscure. Expect to thrash around a little before you figure the process out.

There is no practical upper limit to the number of questionnaires the program can process. If you have to input an extremely large amount of data, you can split the work between operators at different machines, then use the program's File Combine option to consolidate the data.

SumQuest runs fairly quickly when processing data, despite its not supporting a math coprocessor. Basic output includes well-designed reports giving response frequencies and percentiles, and bar graphs showing frequency distribution. Only default summary graphs are available.

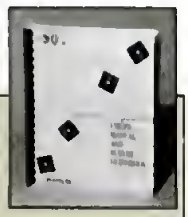
Editing graphs from within *SumQuest* is limited to working with titles. But because they're created using ordinary keyboard symbols and output in ASCII format, it's easy to import the graphs into any word processor. *SumQuest* uses a generic printer driver to print graphs and reports. It works equally well with daisy wheel, dot matrix, and most laser printers.

The package also efficiently handles cross-tabulation of respondent data, both two- and three-dimensional, allowing you to quickly identify target populations in marketing and social science surveys. You're given a great deal of control over the analysis, including weighting and highlighting of significant cells.

Cross-tabulation also includes an option to save your cross-tab data as a *Lotus 1-2-3* file so that you can import it into *1-2-3* or another package for further analysis and graphing.

SumQuest's most powerful feature is

PC MAGAZINE FACT FILE



***SumQuest*,**
Version 3.0
SumQuest Software
908 Niagara Falls
Blvd.
North Tonawanda, NY 14120-2060
(416) 599-0404
List Price: $595; for educational and non-profit institutions, $495.
Requires: 512K RAM, DOS 2.0 or later.
In Short: *SumQuest* is a quirky questionnaire-survey-analysis program written in compiled BASIC that should appeal to do-it-yourself survey takers. Copy protected.

CIRCLE 695 ON READER SERVICE CARD

Cell Search, a utility that can automatically find any significant variances in attitude across such demographic variables as age, sex, income, and the like. Basically, Cell Search cross-tabulates a question against all the other data in your survey. The resulting detailed report shows all demographic relationships within that data. Cell Search also allows you to set the p-value for the level of confidence you require.

SumQuest's greatest failing is poor program error trapping. Pressing the wrong key or forgetting to turn your printer on

SumQuest lets

anyone, even

statistical novices,

conduct a useful,

correctly

designed survey.

produces an unusable error message, and then the program unceremoniously dumps you into DOS. Since you're not told what you did wrong, the process can become aggravating very quickly. *SumQuest* promises to include a list of error-message definitions in the next release.

SumQuest also fails to give you a way out when you make the wrong menu choice. You have to either finish the task or reboot.

If you're willing to put up with these problems, *SumQuest* has just the right combination of features and ease of use to make analyzing a stack of questionnaires a pleasure. It's the right tool for analyzing almost any survey by questionnaire that's conducted in-house by small- to medium-size businesses and social service agencies, or even as part of a school assignment.—**Walt Rowinsky**

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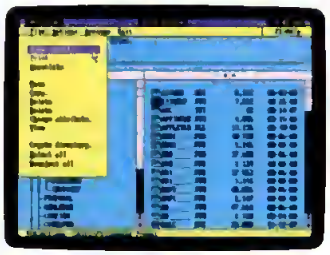
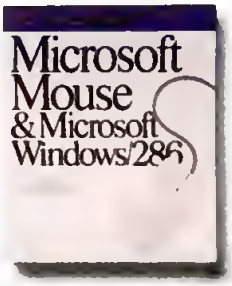


The Microsoft Mouse gives you easy access to all the powerful features today's software has to offer.



It looks innocent enough here, but wait until you see how the Mouse makes your software scream.

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SCIENTIFIC GRAPHING SOFTWARE

NOT JUST A PRETTY PICTURE

For sophisticated images that don't obscure the meaning behind the data, nothing beats these ten scientific graphing packages.

In the scientist's laboratory, this is the best of times—and the worst of times. On every desktop (well, almost) sits a fast, memory-rich PC running word processing and data analysis applications that represent the latest scientific breakthroughs. A graphic illustration will be able to make the point of these discoveries even more forcefully.

The demands posed by scientific illustrations are quite different from those of business graphics. Most business presentation graphics packages don't meet a scientist's needs: they make nice pie charts, but they cannot plot error bars, use logarithmic scales (although a plot of the federal deficit certainly requires such a scale), accept large arrays (thousands of data points). Many cannot rotate the *y*-axis label, as is common in scientific illustrations, or add a legend. (See the sidebar "Presentation Graphics Packages: Getting a Scientist's Points Across" for a discussion of four presentation graphics programs with many capabilities a scientist requires.)

What do plotting scientists need? Not a quick-and-dirty way to sketch data—any spreadsheet does that. Neither can they wait forever for a graph to be plotted on a laser printer—those who can bought Macintoshes. They need high-quality output that can be sent as is to a scientific journal for publication. And they need to be able to produce it quickly, make changes in a straightforward manner, examine the results of the changes on-screen, and then print the graph.

Another requirement for scientific plotting is flexibility in determining the appearance of the graph: arbitrary positioning of the axes, various fonts for appearance and emphasis, arrows, a variety of symbol shapes and sizes, unlimited number of data points and plots per graph, and easy scaling and overlaying facilities are some of the more important essentials.

Many scientists prefer to use laser printers rather than pen plotters for the final output, but few can afford a PostScript printer, so they typically use the ubiquitous HP LaserJet. Plotting a lot of points can take a

WRITE YOUR OWN SCIENTIFIC GRAPHING PROGRAM

GraphiC, from Scientific Endeavors, gives you all the C language routines you need to write an impressive scientific graphing program of your own.

None of the contenders to the title of "The Complete Scientific Graphics Package" has everything it takes to win that title. But do not despair. As H. K. Hartline used to say, "If you want something done right, you have to do it yourself." Fortunately, you do not have to start from scratch to write your own scientific graphing program: *GraphiC* will come to the rescue.

GraphiC, $395 from Scientific Endeavors, is an impressive collection of C procedures and functions that the enterprising scientist might call from his or her own graphics plotting program. Version 4.1 has all the options needed to create a program that could ascend to the aforementioned title.

GraphiC comes with sample graphs and with an interactive PLAY program that allows you to examine some of its features and serves as a starting point for the creation of this ultimate plotting program. Amazingly, Scientific Endeavors has supplied the source code itself, making it possible to modify or add to the impressive variety of features available in *GraphiC*.

The list of features found in *GraphiC* is far too long to include here. A few of the more important ones include linear, log, and semilog plots; polar plots; two- and three-dimensional plots of curves and surfaces; projections of 3-D plots onto a plane; Smith charts; error bars (both *x* and *y*); various fonts in various sizes; a font editor; arbitrary scale factors in logarithmic plots; inset regions in the graph; overlayed graphs; variable line thickness and styles; various filling patterns for bar graphs; arbitrary placement of axes; various arrow styles; and much, much more.

A few features are missing, but they are minor in comparison with the wealth of excellent features found in the program. *GraphiC* supplies only eight symbol types, and these do not include filled circles and triangles, although with minimal work one can fake them. We did not find a way to plot certain contours (say, every fifth one) in color, or the ability to specify the color of a contour when using a plotter.

IMPECCABLE GRAPHS The sample graphs supplied with the program were absolutely impeccable. The program produces plots with a resolution of 4,096 by 3,120 (Tektronix format) and will display or print them at the highest resolution that your printer can handle.

GraphiC is a most useful package, and it might be the only way available right now to satisfy all the needs of the graphing scientist. Highly recommended.—**Ehud Kaplan**

FACT FILE

***GraphiC*, Version 4.1**
Scientific Endeavors Corp.
508 N. Kentucky St.
Kingston, TN 37763
(615) 376-4146
List Price: $395
Requires: Used in conjunction with a C compiler. Memory and DOS requirements will vary with the user's application.
In Short: *GraphiC* is not a plotting program, but a library of graphics procedures (in C) that will allow a good C programmer to write his or her own complete graphics package fairly easily. The list of features and capabilities is long and almost complete. Not copy protected.

CIRCLE 638 ON READER SERVICE CARD

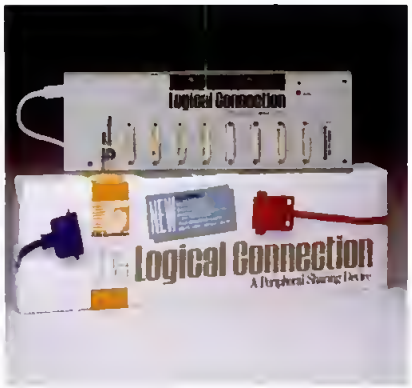
long time. The package must include drivers to take advantage of the LaserJet's built-in Printer Command Language (PCL) so that a graph can be produced in less than 25 minutes—an outrageous, but not uncommon, amount of time to wait for a scientific graph to be printed.

For quite some time, packages sold as scientific graphics programs were only warmed-over business graphics packages designed for needs that were rarely encountered in the scientific community. This left many scientists with no choice but to return to a draftsman and go through the agony and expense of last-minute changes and incorrect plots.

But the publishers of some scientific graphing packages have shown that they're starting to listen to their users. All ten scientific graphing packages we review here have included such essentials as allowing labels to be easily placed and manipulated and allowing the user to specify the endpoints of both the *x*- and *y*-axes. The ability to send a plot to a file that can then be sent to the printer is another valuable feature they included. Of the dedicated scientific graphing packages we've reviewed here, only *Sigma-Plot* has mouse support, which is especially useful in positioning labels and other graph-editing chores.

Our summary of features table serves as a yardstick that you can use to compare the programs now available. Also included in the table are four presentation graphics

What's the most logical way to connect everyone to a laser printer?



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PC MAGAZINE EDITOR'S CHOICE

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products that have some features scientists demand: *Graph Plus*, *GraphStation*, *Microsoft Chart*, and *Perspective Junior*.

ALTERNATIVE SOLUTIONS Several programs other than those included in this review incorporate extensive graphics modules. For example, *Asyst*, *Statgraphics*, *SAS*, and *Matlab* (all reviewed elsewhere in this issue) have powerful graphics capabilities, with *Asyst* offering the greatest flexibility. However, these programs usually do not offer finished graphs of the quality required by scientific journals. *Asyst*, for example, cannot plot logarithmic graphs without making you weep (or laugh hysterically) when you see the numbers it puts on the axes. Another drawback of most analysis packages is that they are considerably more expensive than standalone graphics programs, often costing two to ten times as much. *Sygraph* is another dedicated scientific graphics package reviewed elsewhere in this issue.

The scientific graphics packages reviewed here fall into two main categories: two-dimensional plotting packages and three-dimensional surface-drawing packages. *Grapher*, *Graph-in-the-Box Analytic*, *PCPlot* and *PDP*, *Sigma-Plot*, and *Tech*Graph*Pad* fall into the two-dimensional plotting category.

THE THIRD DIMENSION *Datasurf*, *SDS*, and *Surfer* are three-dimensional packages we looked at in the following reviews. If you don't know much about three-dimensional surface plotting, take a look at *AcroSpin* ($30 from Acrobits, P.O. Box 1302, Menlo Park, CA 94026-1302; (415) 369-0838). *AcroSpin* is not a plotting package but is meant for drawing surfaces and three-dimensional objects on the screen, and then rotating or scaling them freely. The package includes a nice tutorial that takes you through the steps of displaying the various surfaces. The vendor, Acrobits, also includes the Turbo Pascal source code so that you can generate some of your own surfaces.

In a class by itself is *Graftool*, which can produce both two-dimensional and three-dimensional graphs—on the same screen. You'll find a review of this package with the three-dimensional programs.—**Ehud Kaplan**

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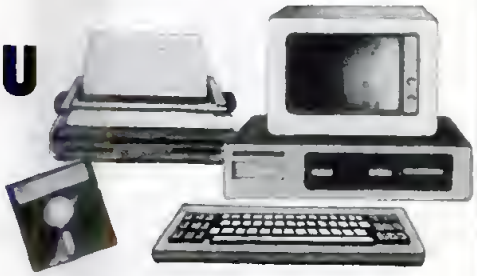

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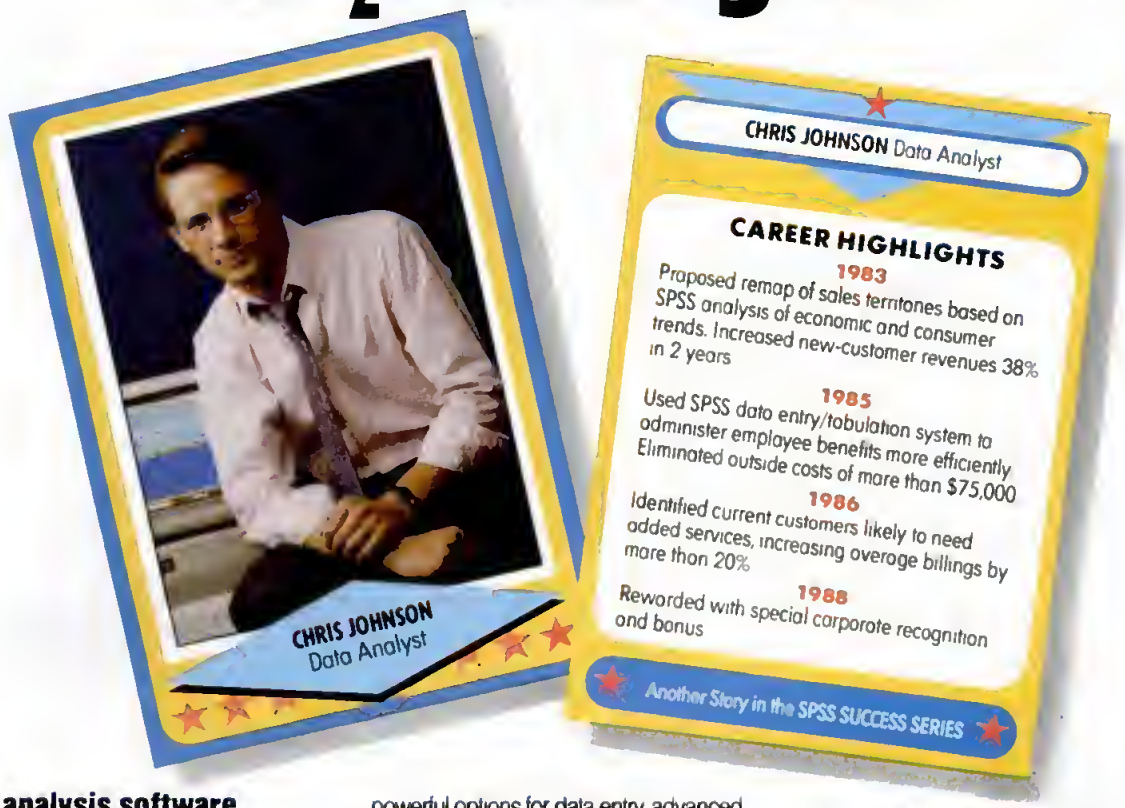

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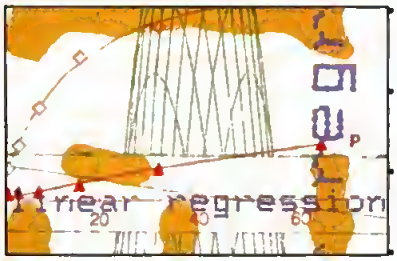


TWO-DIMENSIONAL PLOTTING

To compare the two-dimensional programs, we plotted a typical graph using two sets of experimental data from the exploration of the primate visual system, and two theoretical curves to fit the data. You'll see how well the programs perform on the pages that follow.

Grapher

Grapher's creators, Golden Software, thought of almost everything a scientist needs to create a two-dimensional graph. This $199 program's menus have a consistent, logical style, and you are never at a loss as to what is happening. Because the program is so clearly designed, you can learn to use it within 15 minutes.

Version 1.76 is a significant improvement over previous releases and is within sight of delivering a complete and professional scientific graphing program. You no longer need to store each *x,y* data set in a separate file; legends and titles are now easy to produce, scale, and manipulate; and the program's symbol sets are more complete.

Start out in the novice mode, in which any action that might cause a loss of data or of plotting parameters invokes a warning and requests confirmation. When you become proficient in the program, you can switch to the program's expert mode and skip through the menus, while the program prevents you from taking dangerous shortcuts.

In addition to the *Grapher* program itself, which builds the graphs, you get two modules called View and Plot. You use View to look at the graphs stored on-disk. This module can be used to zoom and pan the graphs. It can also be used to supply *x,y* coordinates for various graph elements, such as the location (in inches) of the legend or title.

The Plot module is used to produce hard copy output from within the program, but you can also use it as a standalone program to plot previously constructed graphs that are stored on-disk. The module is used mainly to plot a large number of graphs in batch mode. This process can be completely automated, as well.

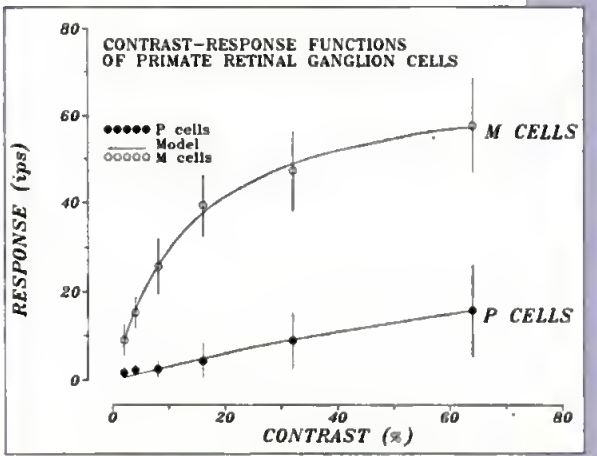
Grapher allows for six ways of fitting functions to your data: linear, spline, power, exponential, polynomial, and logarithmic. The ability to preview the statistics of polynomial curve-fits to the data is a very nice touch. But there is no way to access the fitting statistics when more than one function is fitted, short of reading these statistics as they are sequentially flashed on the screen. It would also be nice to be able to preview the fitting statistics of other functions, as well.

This program allows great flexibility in determining every aspect of a graph's appearance. Almost every element of the graph—symbols, axes, labels, tickmarks—is completely adjustable in shape, position, orientation, size, color, and so on. This great flexibility doesn't come at the expense of ease of use: *Grapher* is, arguably, the easiest graphics package to use for scientists' graphing purposes.

However, the program still has some shortcomings. The inability to determine the line thickness when plotting to a laser printer renders otherwise stunning graphs as anemic printouts: lines a single pixel in width are not bold enough to photograph, project, or even see.

Grapher's inability to use calculated standard deviations makes the process of plotting error bars clumsy and irritating. The program uses the high-low-close method to create error bars, forcing you to calculate the mean ±1 standard deviation. (Programs such as *Sigma-Plot* and *Tech* Graph*Pad* don't require you to do these calculations. They simply accept a column for standard deviations and calculate the rest for you.)

The legends created for the graphs could be improved: the symbols representing the plots are placed too close together and there are too many symbols for each legend item (see the sample output for *Grapher*). The standard method is to use only one or two symbols per plot; one at each end of the line if two are used. The



Grapher's flexibility in determining graphical elements includes positioning the x- and y-axes.

line drawn for the legend is not drawn in the middle of the character; it is too low, and cannot be adjusted. To change the order of the items appearing in the legend, you have to rearrange the graphing order of the plots.

Surprisingly, the program does not produce bar graphs, which are often essential. *Grapher* limits you to plotting ten data sets per graph—and you must overlay graphs if you need more.

Grapher has 16 character sets for labels, captions, legends, and titles, plus a "centered" character set that's used to plot data points. Each set is a specific typeface, with its own weight and characteristic appearance. Each character set should include all symbols, just as all Times Roman fonts have a percent sign or a question mark. For example, if you want the *x*-axis to be bold and it includes a percent sign, then you should have a bold character set complete with a percent sign. Unfortunately, only one character set includes the percent sign. For scientific graphs, all sets should include this symbol. *Grapher* does allow you to create your own symbols, but most people would balk at the need to create standard symbols such as percent signs.

All in all, this program is almost on target. To paraphrase what Mozart said to Salieri in the movie, *Amadeus*: Just fix a few items, and it will be perfect!

—Ehud Kaplan

PC MAGAZINE FACT FILE

Grapher
Golden
Software Inc.
807 14th St.
P.O. Box 281
Golden, CO 80402
(303) 279-1021
(800) 333-1021
List Price: $199
Requires: 320K RAM, DOS 2.0 or later.
In Short: *Grapher* is an excellent scientific graphics program that's also very easy to use. *Grapher*'s only failings are the absence of bar graphs, poor error bars and legends, and lack of line-thickness control. Not copy protected.

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Graph-in-the-Box Analytic

Graph-in-the-Box Analytic, $199.95 from New England Software, is RAM resident, allowing you to grab data directly from the screen of your favorite application, so you can manipulate it to your heart's delight and then output a plot in your favorite format. For ease of use and great menuing, *Graph-in-the-Box Analytic* simply can't be beat. The manuals sat virtually unused as we whizzed through the various plotting options. And we had graphs almost instantly.

The convenience of RAM residency has its price, however; it is compatible only with text-based software. If your favorite spreadsheet runs only in graphics mode (*Microsoft Excel*, for example), your path to graphing is not so glorious. Rather than grab data right off the screen, you must import the data in .DIF files. Although other programs always require importing (or worse yet, keying in) the data, they often deliver extra power in return for your trouble.

Another problem is that *Graph-in-the-Box Analytic* misbehaves with other RAM-resident software, such as *SmartKey*. It's best to clear all TSRs from memory before using this program.

With a wave of your F7 and F8 keys, graphs change color before your very eyes. You can change line styles, symbol types and labels in no time flat. Switching from a spline to a linear-trend graph takes five simple keystrokes. In seconds, you're looking at the changed graph.

While all major graphics output devices are supported, and you can write your output to a file (even to an HPGL or PostScript file), other packages do better when it comes to high-quality output. Laser printing is fast, but *Graph-in-the-Box Analytic* has only one wispy font and a fixed one-plot-per-page format. Whether you like it or not, your plot goes in the upper

PC MAGAZINE FACT FILE

Graph-in-the-Box Analytic,
Version 1.0
New England
Software
Greenwich Office Park #3
Greenwich, CT 06831
(203) 625-0062
List Price: $199.95
Requires: 128K RAM, DOS 2.0 or later.
In Short: *Graph-in-the-Box Analytic* is a TSR that can also be run as a nonresident program. It grabs data from the screen, thereby allowing many input forms. Not copy protected.

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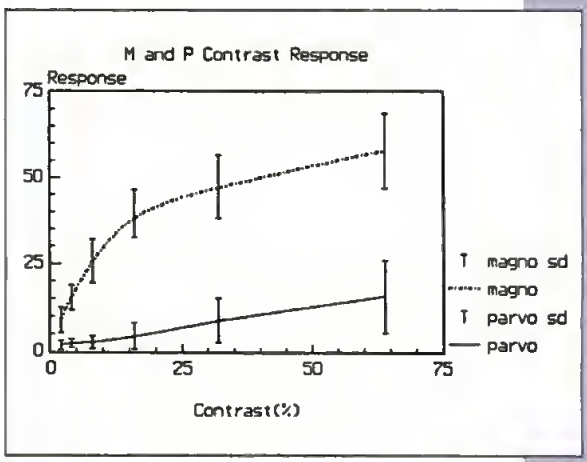
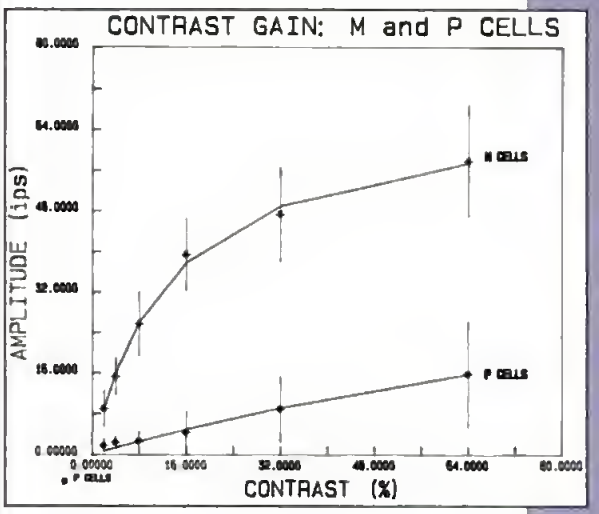


Graph-in-the-Box Analytic always produces graphs in this format: plot in upper left, legend in lower right.

left, and the legend goes in the lower right. The labels are frozen in place, as well.

Graph-in-the-Box Analytic is focused on *x,y* data analysis and handles line, spline, bar, and trend graphs—15 different chart types in all. It also allows logarithmic or linear axes and error bars, although it incorporates error bars through the awkward high-low-close method. It also boasts 45 data-manipulation and calculation options.

Graph-in-the-Box Analytic has only one wispy font.



PDP displays decimal formats, but you have no control over the number of decimal places.

For getting quickly acquainted with your data, this program does a fine job. However, keep in mind that *Graph-in-the-Box Analytic* may stay asleep forever within your pet spreadsheet, and that if it's top-form output you're looking for, you would do well to look elsewhere.

—David P. Edwards

PCPlot PDP

PCPlot ($95), and *PDP* ($95), both from BV Engineering, are inexpensive, easy to use, and usually fast, but they're limited-feature programs that produce nice-looking graphs. The major difference between the two programs is that *PCPlot* can output only screen dumps (using GRAPHICS.COM), while *PDP* plots output to a plotter or an HPGL file that can be edited later or used with *Laser-Plotter*. There is no direct support for other high-quality printers.

Using the programs, however, can sometimes be difficult. You cannot recover from some mistaken entries. The manual says to type q, but that doesn't work, for example, when the program expects a filename.

You cannot view the graph while you're making changes—you must go up to the appropriate level in the menu to view your changes. And the program rereads the data file every time you plot! If you plot a large data set (or several such sets) and make frequent changes to your graph, you'll want to have a very fast disk and a lot of patience.

Each plot (set of *x,y* data points) is an independent file. This is such a bad idea that most users would probably despair of using this program for anything but the most trivial of graphs. The tiny data files proliferate and clog the directories like algae in Florida's rivers.

PDP can handle only six plots per graph, and if you try to overlay plots, the axes get replotted. The program does not have fonts, just HP plotter characters; this is usually not good enough for publications. *PDP* can't write numbers in the format 10^2. The program supports decimal and scientific formats, but there is no control over the number of decimal places. Scientific notation is rarely used in graphs; for example, the number 1,000,000 should be written as 10^6, not as 1E06 or 1000000.000.

PDP can plot error bars, but they cannot be supplied as a single standard deviation column; you have to calculate the mean ±1 standard deviation. Didn't IBM teach us that "machines should work, people should think"?

To its credit, BV Engineering's technical support was very good. But they appar-

FACT FILE

***PCPlot*, Version 3.25**
***PDP*, Version 2**
BV Engineering
2023 Chicago Ave.,
Suite B13
Riverside, CA 92507
(714) 781-0252
List Price: $95 each
Requires: 256K RAM, DOS 2.0 or later (for both).
In Short: *PCPlot* is limited in features but easy to use and inexpensive. The software is for viewing graphs on-screen, since output quality is limited. *PDP* is almost identical to *PCPlot* but is for driving a plotter and has a few more features, such as the ability to create a legend. Plotter output is nice but not stunning. Both packages share similar problems, including no curve fitting, no fonts, and slow plotting (it rereads the data to plot each time). Moreover, each plot (*x,y* data set) is an independent file. *PCPlot* and *PDP* are not copy protected.

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Scientific Graphing and Presentation Graphics Software: Summary of Features

(Products listed in ascending price order within category)

SCIENTIFIC GRAPHING SOFTWARE

Two-Dimensional Programs

	PCPlot	PDP	Grapher	Graph-In-the-Box Analytic	Sigma-Plot	Tech-Graph-Pad
GENERAL PROGRAM FACILITIES	$95.00	$95.00	$199.00	$199.95	$395.00	$395.00
Data import						
Lotus 1-2-3 files	○	○	○	○	○	●
.DIF files	○	○	○	●	●	○
On-line help	○	○	●	●	○	●
EGA support	●	○	●	●	○	●
Runs from batch file	●	●	●	○	○	○
CALCULATING CAPABILITIES						
Performs arithmetic	● (multiplication only)	● (multiplication only)	○	●	●	○
Calculates standard deviation	○	○	●	●	●	○
PLOTTING CAPABILITIES						
Maximum number of points per data set	1,000	1,000	32,000	500	65,000	Unlimited
Scientific symbols and Greek letters plotted	●	○	●	○	●	●
Several symbols to plot points	●	●	●	●	●	●
Line style options	●	●	●	●	●	●
Line thickness options	○	○	○	●	●	●
Grid line options	●	●	●	●	○	●
Composite graphs	●	●	●	○	●	●
One-key rapid plotting	○	○	●	●	○	○
Log and log-linear plots	●	●	●	●	●	●
Arbitrary multiplier in log scale	○	○	○	○	○	○
TWO-DIMENSIONAL PLOTTING						
Maximum number of data sets (plots) per graph	6	6	Unlimited	10	126	8
Error bars (x and y axes)	●	●	○	●	●	●
Bar graphs with optional error bars	●	●	○	●	●	○
Polar plotting	○	○	○	○	○	●
Several ways to fit curves to data	○	○	●	●	●	●
GRAPH EDITING CAPABILITIES						
Data clipping	○	○	●	○	●	●
Labels/legends						
Flexible and self-updating legends	○	●	●	●	●	○
Several fonts for labels	○	○	●	○	●	●
Label rotation in 90-degree steps	●	●	●	○	●	●
Unrestricted label rotation	○	○	●	○	○	○
Labels positioned near individual points	●	●	●	●	●	●
Arrows pointing to portions of graph	○	○	○	○	○	●
Axes						
Adjustable tick marks on axes	●	●	●	○	●	●
Axes allowed on all four sides	●	●	●	○	●	●
Arbitrary positioning of axes on page	○	○	●	○	○	○
Adjustable format for numbers on axes	●	●	●	○	●	●
OUTPUT						
Printers						
Dot matrix	○	○*	●	●	●	●
Laser	○	○*	●	●	●	●
Color	○	○*	●	○	●	●
Film recorders	○	○	○	●	○	○

—Editor's Choice ●—Yes ○—No N/A—Not applicable. 3-D packages do not perform 2-D functions. *This product supplies plotter output only.

PRESENTATION GRAPHICS SOFTWARE

2-D & 3-D Program	Three-Dimensional Programs			Two-Dimensional Programs			2-D & 3-D Program
Graftool $495.00	**Datesurf** $125.00	**Surfer** $499.00	**SDS** $995.00	**Microsoft Chart** $395.00	**Graph Plus** $495.00	**GraphStation** $795.00	**Perspective Junior** $149.00
○	●	○	○	●	●	●	●
●	○	○	○	○	●	○	●
●	○	●	○	●	○	●	●
●	●	●	●	●	●	●	●
○	○	●	●	○	○	●	○
●	○	●	○	●	●	○	●
●	○	○	○	○	○	○	○
10,000	32,000	10,000	3,000	32,767	Unlimited	32,000	4,096
○	○	●	○	○	●	○	○
●	○	●	○	●	●	●	●
●	○	●	●	●	●	●	○
○	○	○	●	●	●	●	○
●	○	●	●	●	●	●	○
●	○	●	●	●	●	●	○
●	○	●	○	○	●	○	○
●	●	●	●	●	●	●	○
○	○	○	●	○	○	●	○
Unlimited	N/A	N/A	N/A	1,024	Unlimited	100	4,096
●	N/A	N/A	N/A	●	● (y axis only)	○	○
●	N/A	N/A	N/A	●	○	●	○
●	N/A	N/A	N/A	○	○	○	○
●	N/A	N/A	N/A	●	●	●	○
○	○	●	●	●	●	●	●
●	○	●	○	●	○	●	○
●	○	●	○	●	●	●	●
●	○	●	●	●	●	●	● (on 3-D graph)
●	○	●	○	●	●	○	● (on 3-D graph)
●	●	●	○	●	●	○	● (on 2-D graph)
●	○	○	○	●	●	●	○
●	○	●	●	●	●	●	○
●	○	●	●	○	●	●	○
○	○	●	○	●	●	●	○
●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●
●	○	●	●	●	●	●	●
●	○	●	●	●	●	●	●
○	●	○	●	●	○	●	Optional ($69)

PRESENTATION GRAPHICS PACKAGES: GETTING A SCIENTIST'S POINTS ACROSS

Several business-oriented presentation graphics packages claim to have the features that scientists need. Four—*Graph Plus*, *GraphStation*, *Microsoft Chart*, and *Perspective Junior*—in particular, stand out from the pack. We've included these four programs in our features table so you can compare their features with the dedicated scientific graphics packages we've reviewed in this article. A more general discussion of what these programs are like to work with—from a scientist's point of view—follows. (See *PC Magazine*, September 27, 1988, for complete reviews of *Graph Plus* (page 136), *GraphStation* (page 140), and *Microsoft Chart* (page 155).)

Graph Plus, $495 from Micrografx, runs under *Microsoft Windows*. It makes great-looking graphs, since it takes full advantage of the entire *Microsoft Windows* arsenal: fonts, large number of line thickness and styles, printer drivers, color, cut and paste, mouse control over everything in sight, and more. Graph editing is especially easy with a mouse.

Graph Plus allows easy overlaying and scaling of several graphs on a single page, including their various labels, legends, and so on.

Because *Graph Plus* can mix graphics and text on one screen (or printout), its captions and labels are among the nicest of any program reviewed here, as long as you have font cartridges or the soft fonts required for your printer.

But the program does have some shortcomings when used to graph a scientist's data. If one data set is graphed with a curve drawn through the data points, all the plots must be graphed the same way: plotting one data set as markers (filled circles, for example) and a theoretical function as a line is an exercise in frustration. To do this you must either select overlapping markers and lines and make some of them invisible, or overlay graphs. Ideally, you should be able to plot experimental data as points without a curve drawn through them, and theoretical functions as curves without data points.

While the legend uses colors as a guide to the various plots, this distinction gets lost on a laser printer. Legends should reflect the symbols used in the graph, and color should be used as a secondary, optional clue.

GraphStation, $795 from Software Clearing House, combines two modes of preparing graphs: Graph, in which you do the usual plotting of points, lines, bars, and so on; and Draw, where you add final touches to your drawing, with many useful enhancements. We looked at Version 3.13; the vendor plans to release Version 4.0 in the first quarter of 1989.

GraphStation has an intelligent user

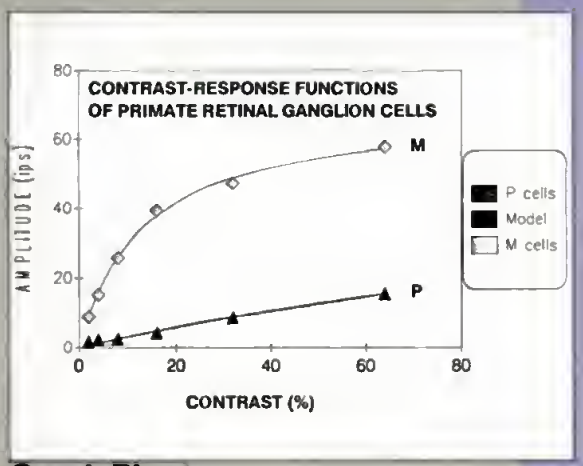
FACT FILE

Graph Plus
Micrografx
1303 Arapaho Rd.
Richardson, TX 75081
(800) 272-3729
List Price: $495
Requires: 512K RAM, *Microsoft Windows* 2.0 or later, DOS 2.0 or later.
In Short: *Graph Plus* is incredibly easy to use—;and it puts all the power of the *Windows* environment at your disposal. Unfortunately, the program's error-bar plotting is atrocious, and the legend is nearly useless. Not copy protected.
CIRCLE **633** ON READER SERVICE CARD

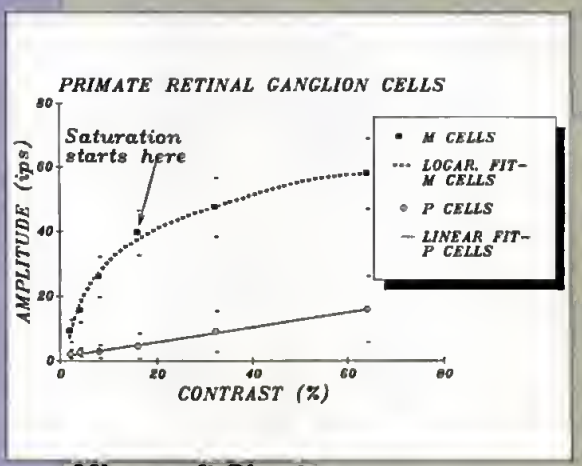
GraphStation, Version 3.3
Software Clearing House Inc.
895 Central Ave.
Cincinnati, OH 45202
(513) 579-0455
Lisl Price: $795, with a mouse included.
Requires: 640K RAM, DOS 2.0 or later.
In Short: A powerful, flexible, and expensive ($795; 25 percent educational discount) program for two-dimensional graphs. It features full mouse support and an intelligent user interface with many nice "final touches." Save the manual, since not all aspects of the user interface are intuitive and obvious. Error bars will be available only in the nexl version (4.0), and no splines are available yet. Not copy protected.
CIRCLE **632** ON READER SERVICE CARD

***Microsoft Chart*, Version 3.0**
Microsoft Corp.
16011 NE 36th Way
Box 97107
Redmond, WA 98073-9717
List Price: $395
Requires: 320K RAM, DOS 3.t or later.
In Short: *Microsoft Chart* is a serious attempt at producing the complete graphics package; it has more features than many graphics programs. Unfortunately, error bars, clumsy data input, and poorly drawn circles (as markers) marr the program. Not copy protected.
CIRCLE **631** ON READER SERVICE CARD

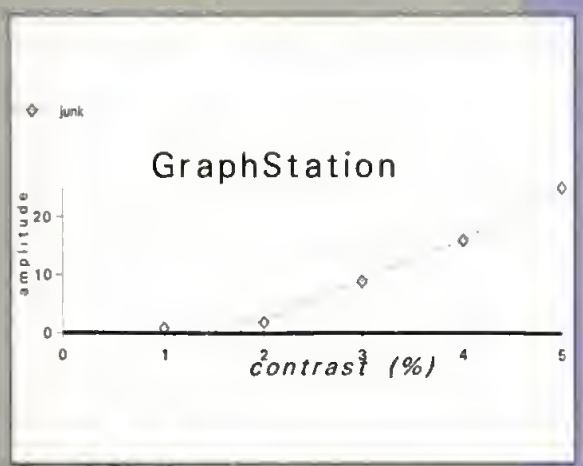
***Perspective Junior*, Version 1.0**
Three D Graphics
860 Via de la Paz
Pacific Palisades, CA 90272
(213) 459-7949
List Price: $149; Option Pak, $69.
Requires: 512K RAM, DOS 2.0 or later.
In Short: Although not a scientific graphics package, *Perspective Junior* has some unique capabilities, such as displaying multiple data sets in 3-D bar charts that are absolutely stunning. The package is easy to use; with the Option Pak, it has serious math in the spreadsheet and support for fancy output. Drawbacks include no error bars in 2-D plots, and the spreadsheet might be too small for some jobs. Not copy protected.
CIRCLE **630** ON READER SERVICE CARD



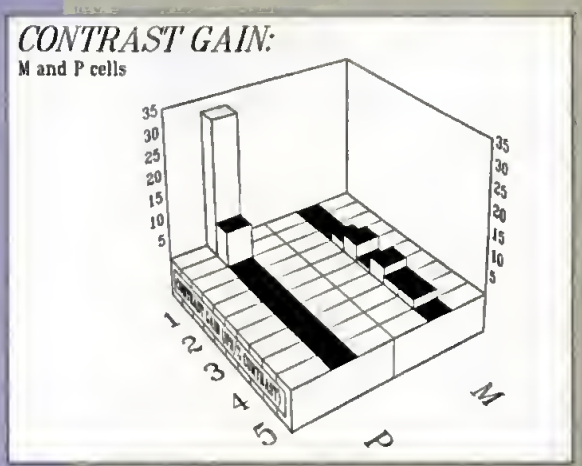
Graph Plus



Microsoft Chart



GraphStation



Perspective Junior

interface, for the most part, and makes good use of the mouse. The program sports many curve-fitting options and gives you significant control over the appearance of all parts of the graph: line style and thickness, symbol size, axes and label positions, label fonts, and more.

Version 3.13 does not have error bars, making the program unusable for many scientific graphs. Although Version 4.0 will have them, they were handled poorly in the beta release we saw. You have to supply standard deviations as a separate data set, repeating the *x* values, and *y* error bars were not available.

The program does not include a spline function, which is used to draw smooth curves through the data points. *GraphStation* lets you save the data, the image you have drawn, or the format with the graphing instructions to a disk file. However, if you forget to save both data and the graph format—and the program lets you forget—the format is lost. You should be able to save all three in a joint file and be able to access the individual aspects of the graph.

GraphStation goes a long way toward supplying everything you need for two-

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"Presentation Graphic's Packages" (continued)

dimensional graphs, but its current shortcomings are too serious for it to be considered an appropriate replacement for the best scientific graphing programs. For this price tag you would expect to get splines and all the other possible trimmings.

A SERIOUS PROGRAM FOR 2-D CHARTS *Microsoft Chart*, $395 from Microsoft Corp., is a serious program for two-dimensional graphs. It is brimming with options and features, some of which are still on the wish lists for the other programs we've reviewed in this article.

This program produces really nice graphs, with beautiful fonts, arrows, excellent legends, easily edited and adjustable titles, and much more. There are certain aspects of *Microsoft Chart* that are particularly good for scientists, such as curve fitting, descriptive statistics, and various data transformations.

But there are a few areas in which the program falls short of the ideal for scientific plotting. The selection of symbols for plotting the data points (markers) is inadequate. The empty circles, for example, look bad enough to keep you from sending the results to a journal, and you can't change the symbol size.

The only way to plot error bars, routine in scientific plotting, is to overlay them on top of the graph. And you can only plot the tops and bottoms of the error bars, which end up being slightly misaligned with the data points above and below them.

Like several of the other presentation graphics programs, *Microsoft Chart* is close to being good enough for scientific graphics but still has some near-fatal flaws.

Perspective Junior, $149 from Three D Graphics, is the son of *Boeing Graph:* it's both a new version of that venerable program and a reduced version.

Version 1.0's main use is to plot arrays of numbers in three-dimensional bar charts, in which the various data sets are arranged in rows that are displaced from each other on the plot. *Perspective Junior* offers a huge number of shapes, patterns, and colors that you can combine and apply to risers depicting your data sets. Some of the graphs it produces are really spectacular.

This program is not really meant for publication-quality scientific graphs. However, a scientist also projects slides showing experimental results; these slides could be made more attractive and effective if they were prepared with *Perspective Junior*. Excellent use of color and three-dimensional appearance makes the slides very impressive indeed. The program also comes with a slide-show editor, which allows you to sequence images on the screen for manual or automatic display of the various graphs. This would be useful for poster sessions in scientific meetings, for example.

In going from *Boeing Graph* to *Perspective Junior*, the size of the data spreadsheet was reduced to 4,096 cells. For many applications this is still adequate, but not for most surface plots. Now you are limited to choosing among four versions for the title and subtitle; *Boeing Graph*'s label manager was not included in the new program.

On the other hand, *Perspective Junior* is an improvement over *Boeing Graph* in several ways: it's faster, the user interface has been greatly simplified, keyboard macros were added, and graphs can now be saved in a single file. It's faster to print your graph on a laser printer and easier to prepare a graph for printing. For example, you can now visually stretch a graph on a page layout until it has the aspect ratio you like, then print it.

The Option Pak, available for $69, includes math utilities for data manipulations, plotter support, Polaroid Palette support, and the ability to export in .PCX and .SCR formats.

The two-dimensional capabilities of *Perspective Junior* are strictly business-class: no error bars, no logarithmic plot, virtually no control over tickmarks, no symbols to choose from. But the three-dimensional charts are really eye-catching—and infinitely customizable.

—Ehud Kaplan

ently never looked at the other scientific graphics programs on the market. At $95 for either *PDP* or *PCPlot*, you get what you pay for.**—Ehud Kaplan**

Sigma-Plot

At $395 *Sigma-Plot*, from Jandel Scientific, produces excellent output but is marred by an infuriating user interface and slow output to laser printers. Version 3.1 has been speeded up considerably, but you still need to make your way through myriad menus just to see the effects of your changes.

Sigma-Plot forces you to go through each menu layer since the keys function differently within each menu. To make matters worse, sometimes you choose options by selecting a function key, at other times it is a number, and at other times a letter.

Sigma-Plot gives you a lot of control over the way your graphs look. It produces line plots or bar graphs with good-looking legends, error bars, and text blocks. The major factor contributing to the sharpness of the output is the control you have over line thickness when plotting to a laser printer. It makes all the difference in the appearance of a graph.

Sigma-Plot lets you create your legends item by item in the order you want, so you don't have to be concerned with the order in which you graph your plots (in contrast with *Grapher*). The program's treatment of error bars is the best we've seen so far. Its error bars are drawn correctly (for both *x*- and *y*-axes); they look nice, and since you can supply them as a separate column of input, they're easy to create.

The program does have its limitations, however. You cannot position the axes wherever you want (such as away from the data) and the fonts *Sigma-Plot* supports are

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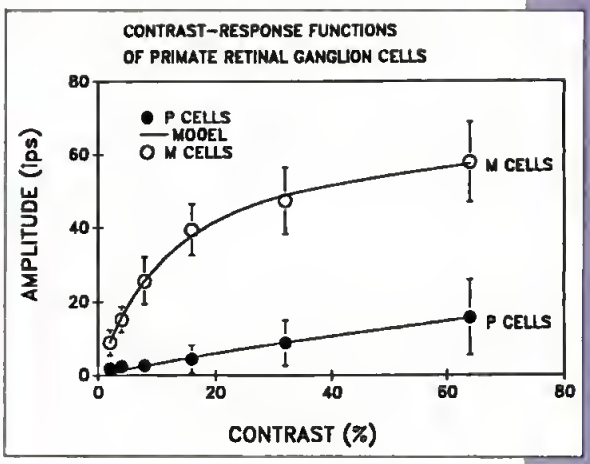


Sigma-Plot gives you control over line thickness, producing some of the best-looking graphs we've seen.

not as good as standard fonts. Under close scrutiny they appear somewhat rough, even on a laser printer.

Editing labels is clumsy, slow, and annoying. You need to capture labels to move them, size them, edit or delete them, and there isn't an easy way to capture a label once you've created it. You have to go to a menu and select the label you want to edit; if the label is part of a legend, it doesn't appear on the menu. (The capture feature that *Grapher*, *Graph Plus*, and *GraphStation* use is a much nicer way to edit labels.) And after you change the aspect ratio in the compose menu, the labels are all in the wrong positions: they are not attached to the items on the graph they are meant to label.

Available at a keystroke, *Sigma-Plot*'s context-sensitive on-line help is so good that the manual is hardly necessary. Nevertheless, the manual is also clear and fairly complete should you need to use it.

Plotting to an HP LaserJet is painfully slow. It is almost impractical for complex graphs, which can take as long as 2 hours to print. The graph reproduced here took approximately 11 minutes to print. With Version 3.1, you can get around this problem by plotting to a file, pretending to have an HP plotter, and then using the $150 *Laser-Plotter* program to convert the HPGL file to PCL.

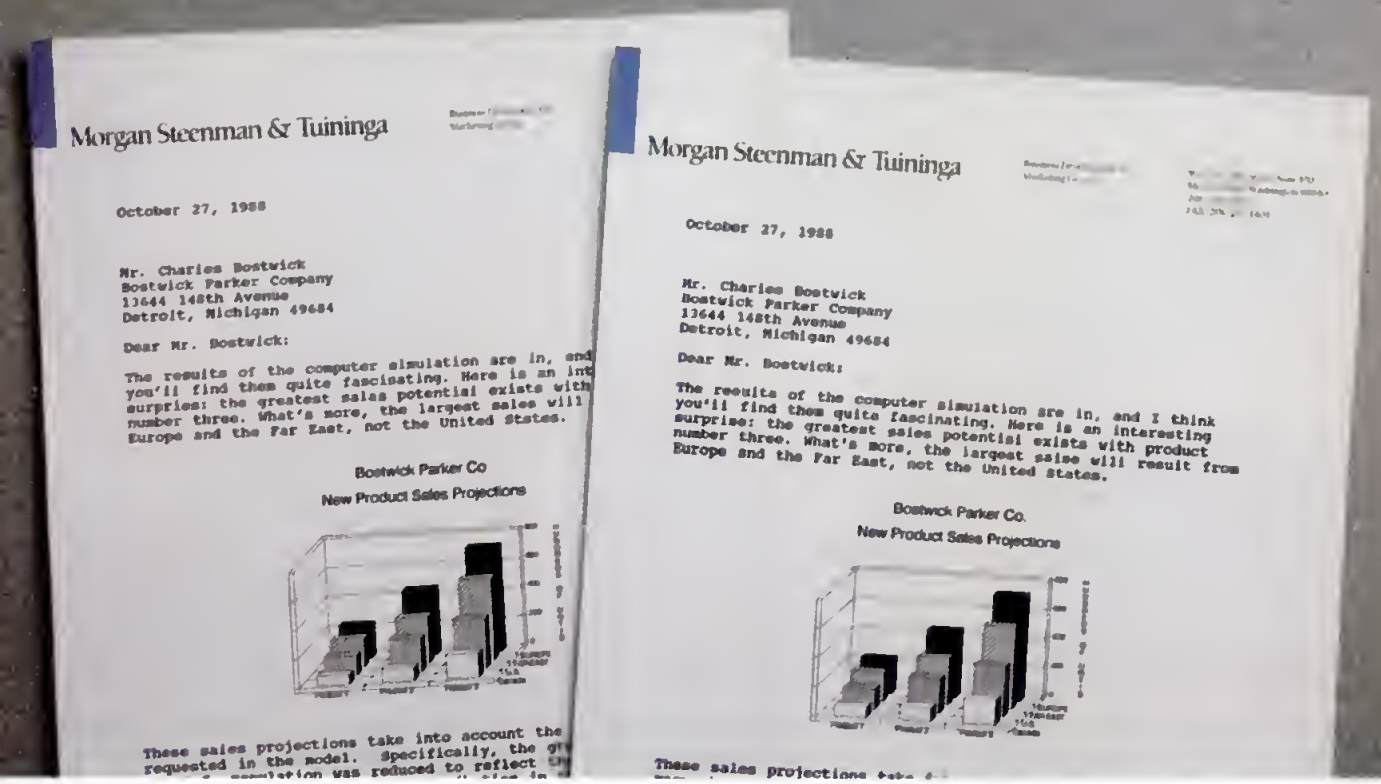
Jandel Scientific's technical support

FACT FILE

Sigma-Plot,
Version 3.1
Jandel Scientific
65 Koch Rd.
Corte Madera, CA
94925
(415) 924-8640
List Price: $395
Requires: 640K RAM, DOS 2.0 or later.
In Short: A complete program, *Sigma-Plot* produces very nice-looking graphs. However it suffers from a poorly designed user interface and slow printing on laser printers, and the fonts have room for improvement. Not copy protected.

CIRCLE 626 ON READER SERVICE CARD

Sigma-Plot lets you create your legends item by item.



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staff was very knowledgeable and polite. Although the company says it will release a new version of the product with a less-frustrating user interface, Version 4.0, to be released in the second quarter of 1989, will apparently still retain the current awful interface.—**Ehud Kaplan**

Tech*Graph*Pad

*Tech*Graph*Pad*, $395 from Binary Engineering, produces very nice graphs on an HP LaserJet in a very short period of time. The graph reproduced here took only 72 seconds to print; compare that with 11 minutes for *Sigma-Plot*.

Although the program is not hard to use, there are times when you are left to guess at the meaning of prompts, or at what answers are allowed.

The line editor used for editing data files is as bad as EDLIN, but, with some teeth-grinding, it can be used. One of the program's nicer features is its ability to use polar coordinates.

Other nice features of *Tech*Graph*Pad* are fast, good-looking output, Greek and other special symbols, support for several output file formats (.PIC and HPGL), and its ability to plot smooth curves through data in several ways instead of being limited only to splines.

If you plan to plot data with error bars, you must name them with an .ERR extension. Failure to do so will crash the system, and you will lose your precious work. Providing you don't input Ctrl-Alt-Del, no program should ever be crashable from the keyboard, especially as the result of such a minor transgression as this.

Once the program starts plotting, there is no way to stop it. And the plotting sequence is mindless: if the tickmarks appear in a color different from their labels, the pen is changed for each tickmark, increasing the plotting time by a huge factor. If the program were to finish plotting each color before changing pens, it would decrease the plotting time significantly. The program ignores tickmark instructions when it's plotting in log-scale mode. Users have the funny idea that, if the program allows them to type in a number, the number would be used correctly, not ignored.

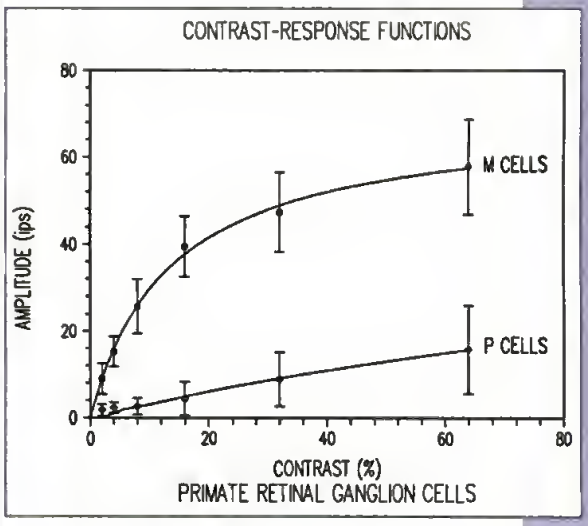
*Tech*Graph*Pad* imposes some serious limitations in terms of what you can and can't do. You have no control over line thickness or symbol size. The variety of symbols is too small to ensure the distinct appearance of the data sets: filled circles, filled squares, and so on, are not available. And you're limited to plotting only eight plots per graph.

This program cannot plot a legend. Instead, it lets you put several text blocks on the graph (and this is possible only in certain cases when the plots are not close to each other) and you have to reposition the labels if you rescale the graph.

We also had difficulties producing the sample graph—it produced a curve different from those produced by the same data given to all two-dimensional packages. This could be a bug in the spline routine. We had to calculate the theoretical function in the test graph with a much tighter mesh. (Mesh is simply an array of data points that needs to be calculated. A tighter mesh means we had to use more points spaced more closely together; we used 64 points, instead of the original 6, to get the plot shown.)

Once *Tech*Graph*Pad* starts plotting, you can't stop it.

*Tech*Graph*Pad*'s ease of use and



***Tech*Graph*Pad* doesn't give you control over line thickness or symbol size.**

FACT FILE

Tech*Graph*Pad
Binary Engineering Software
400 Fifth Ave.
Waltham, MA
02154
(617) 890-1812
List Price: $395
Requires: 512K RAM (640K RAM recommended), DOS 2.1 or later.
In Short: Although its variety of data-point markers and spreadsheet capabilities for data transformation are inadequate, *Tech*Graph*Pad* is fast, easy to use, and produces good-looking graphs. Not copy protected.

CIRCLE **625** ON READER SERVICE CARD

PC MAGAZINE EDITOR'S CHOICE

- **Grapher**
- **Sigma-Plot**

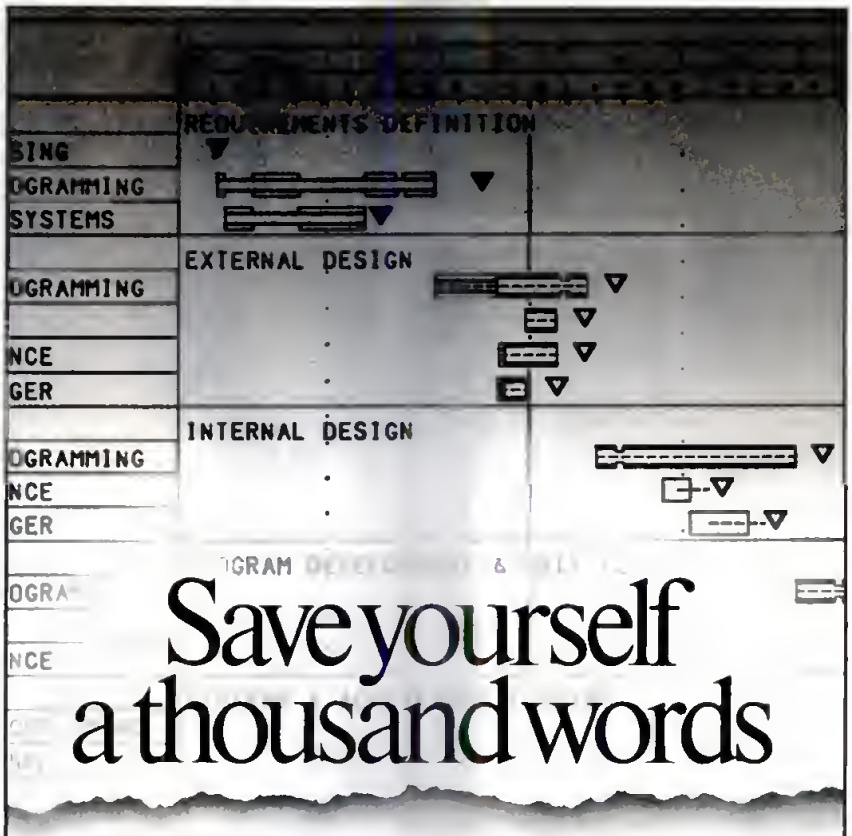
Grapher *is a pleasure to use and requires no manual (although an excellent one is supplied); it's fast and almost infinitely flexible. It's very close to being the ideal scientific plotting package, a mark it misses by neglecting only a few items: line-thickness control for laser printers, having the percent sign in only one character set, poor legends, and a few other details. These oversights make its graphs, which are spectacular on the screen, look somewhat anemic when plotted on a laser printer, although they still look nearly perfect on a plotter.*

Sigma-Plot, *on the other hand, is a very irritating program: its installation is annoying (filling your CONFIG.SYS file with its drivers, robbing you of memory), and the user interface is designed with total disregard to the way people work. However, the final output (on a laser printer), is very good—often as good as you can get from most artists, especially if you don't try any overlaying and scaling of graphs. And, in the final analysis, perfect output is what you want.*

Right now, however, neither is perfect.

Microsoft Chart *is also a very competent program, with many bells and whistles. However, bringing data from other programs is clumsy, plotting error bars is difficult, and the symbols (markers) available for plotting the data are, as of now, inadequate.*

speedy printing of high-quality graphs are good features on which to build, but in its current incarnation this program lacks the features necessary to make it a full-featured scientific graphing program.
—**Ehud Kaplan**



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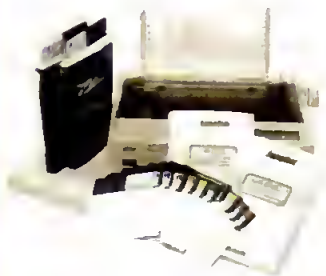

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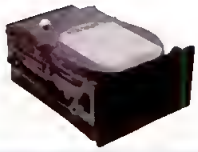

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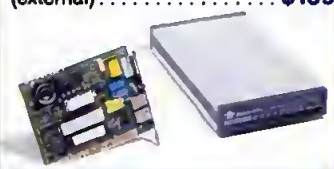

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THREE-DIMENSIONAL PLOTTING

Three-dimensional graphing programs create a surface plot from a mesh of *x,y,z* data points. A regular mesh of *x,y,z* data points is a matrix of numbers (as in a spreadsheet), in which the row and column position of a number represent the *x,y* position in a plane, and the number in the cell is the *z* value, or the height of the data point above (or below) the plane.

If measurements are not made at regular *x* and *y* intervals, but—as is usually the case—at only a few representative locations in the *x,y* plane, then you need a method to calculate the height of the points (between the points you did measure) that you did not measure. This is what the interpolation algorithms do. The program can now stretch the calculated surface over the measured and interpolated *z* values, creating a three-dimensional surface.

A wire mesh of 3-D plots is simply the regular grid of constant *x* and constant *y* values, which is draped over the imaginary sticks (the *z* values of the *x,y,z* triplets). A good illustration of wire mesh would be a fisherman's net slung over some poles in the sand.

Datasurf

Datasurf, $125 from Bridge Software, seems like it's from a previous generation of software. It has a feeling of "look what I managed to do with my computer," and, compared with *SDS*, *Graftool*, or *Surfer*, what it can do is hardly impressive.

Version 2.0 can plot a regular grid of *x,y,z* information—for example, the number of muggings in New York City's Central Park (*z*) as a function of the day of the month (*x*) for 12 months (*y*). The values are plotted as sheets (in our example, 12 of them), and stacked behind each other. The program can also display the tops of the sheets to produce a wire-mesh display of the three-dimensional surface, but the results are far from breathtaking.

Datasurf can output to a dot matrix printer—hardly a publication-quality device—and produce displays that, on my EGA screen, were disappointingly poor. The program's resolution limitations occur primarily because the program, unlike other surface-drawing programs reviewed here, does not interpolate (smooth by interposing intermediate values) between the given data points. For $27, Bridge Software will send you a driver for an HP plotter, and you can then filter the output through a program like *Laser-Plotter* to print it on the HP LaserJet.

Input is clumsy, and if it comes from a spreadsheet or an ASCII file, it has to be translated by running a separate conversion program. This could have been done by the program directly, simply by detecting the extension of the input file. You can type numbers directly into a binary file, which the program can use without translation. However, *Datasurf* has no editing capabilities: if you make a mistake, you have to type the entire file again. And you cannot recover from an erroneous menu choice. Some scientists make mistakes, from which they need to recover.

The program could be useful for students who want to view plots of equations in three dimensions. It comes with a manual that is clear but has no index, and with Turbo Pascal source code that can be modified so that you can generate some surfaces of your own.

We have become too spoiled to use programs with this low a level of sophistication: *Datasurf* is certainly no threat to the employment prospects of scientific illustrators.—**Ehud Kaplan**

FACT FILE

***Datasurf*, Version 2.0**
Bridge Software
P.O. Box 118
New Town Branch
Boston, MA 02258
(617) 527-1585
List Price: $125; driver for HP plotters, $27
Requires: 320K RAM, DOS 2.0 or later.
In Short: A limited-feature program with less-than-stunning output. *Datasurf* could be used by students to explore 3-D surfaces. Data input is clumsy, and the software doesn't have fonts. Not copy protected.

CIRCLE 637 ON READER SERVICE CARD

Graftool

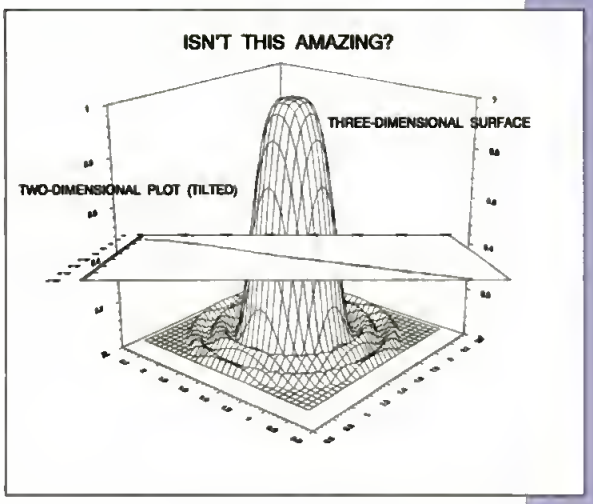
Graftool, $495 from 3-D Visions, is a very impressive program that has some unusual (and useful) capabilities. It produces both 2- and 3-dimensional high-quality plots, either on the screen or on a variety of output devices. Completely menu driven, it sports a clever and somewhat unusual user interface.

We tested Version 1.1 of the program and also looked at a beta copy of Version 2.0. Version 1.1 has a few bugs, of which 3-D Visions is aware; they've been corrected in Version 2.0.

Graftool can plot in all three coordinate systems—rectangular, cylindrical, and spherical—simultaneously and imposes no limit on the number of plots/graphs. It generates not only the standard types of plots—bar, column, and line charts; and scatterplots, with error bars in both the *x* and the *y* dimensions—but can also draw Smith charts, data-eye diagrams, parametric graphs, and more.

You can sequence images to produce slide shows—to present your results during poster sessions in scientific meetings, for example. You can even zoom in on any portion of a plot.

Among the other elements that make this graphics program unique are the data-analysis features built into it. First, you



With *Graftool*, you can draw a 3-D surface, move it to any position, and then add a 2-D plane at any angle.

plot a graph on the screen. Then move the cursor on the graph's curves, extract pieces of them, and perform forward or inverse fast Fourier transforms (FFTs) on the data or run various kinds of regressions.

Graftool's most striking feature is its ability to mix plots in various coordinate systems and manipulate (move, size, erase, label) each of the plots independently. For example, you can draw a 3-D surface, move and rotate it easily and interactively to the position and tilt you wish, and then add a two-dimensional plane, at any angle, with a plot on it.

In my field, I can imagine plotting brain activity in three dimensions and then floating the 3-D surface plot over a 2-D map of the brain, in order to associate activity centers with brain landmarks. This option might come in handy if you are an engineer at mission control. In any event, it's impressive yet easy to use.

The legend system is particularly good: it's a simple matter to produce a legend and then place it wherever you want.

The method *Graftool* uses to specify the details of each plot is confusing and unnecessarily difficult. I suppose that if one is determined enough it's possible to learn anything, but the need to specify line styles in a hexadecimal code or to choose symbols by codes is unpleasant.

Another shortcoming of the program has to do with manipulating graphs containing several objects. The cursor that indicates which object you want to edit in a graph doesn't blink, so it's difficult to tell which object your cursor is actually on. A solution to this problem would be to give an indication—the object's number or name—in an unused area of the screen. An Undo key would be another nice addition to the program, since erasing the wrong item can really hurt.

The manual is excellent, with many examples, including complete replications of the data files that produce the sample graphs included with the program. This seemingly trivial piece of information is rarely given in such complete detail and is highly appreciated. An additional nice touch is the appendixes, which include descriptions of some of the analysis and smoothing procedures, such as cubic splines, FFT, and regression.

The beta copy of Version 2.0 that we looked at ran somewhat more slowly. This is because it supports more output devices and therefore forgoes direct writing to the screen, as Version 1.1 did. But the addition of some excellent fonts makes speed a secondary consideration. The spreadsheet capabilities are also more powerful in Version 2.0.

Graftool's main weaknesses are its inability to control the size of symbols and line thicknesses and that there are no filled symbols at all. These are trivial omissions, especially compared with what the program has already accomplished. It seems as if the programmers did the spectacular fireworks first and neglected the elementary, bread-and-butter components. However, in talking with the company, we found them eager to incorporate user suggestions.

Graftool has the potential to be the ultimate graphics package, fulfilling everybody's needs.—**Ehud Kaplan**

FACT FILE

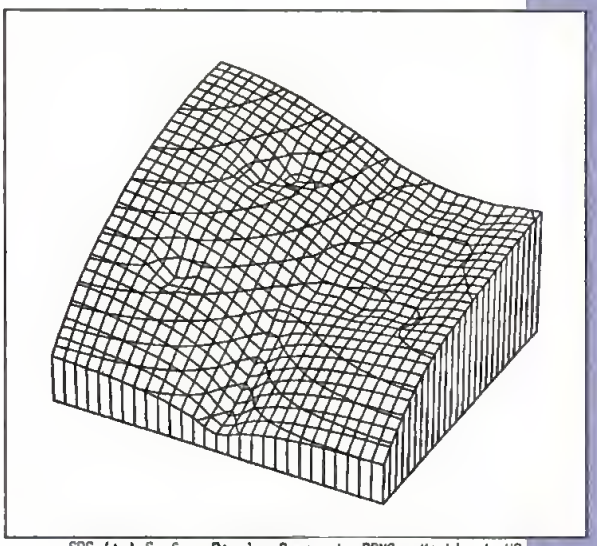
***Graftool*,**
Version 1.1
3-D Visions
1520 23rd St.
Manhattan Beach,
CA 90266
(213) 831-4671
List Price: $495
Requires: 512K RAM (640K RAM recommended), DOS 3.0 or later.
In Short: *Graftool* is a most impressive achievement. It is the only scientific graphics package we reviewed that can draw both 2-D and 3-D graphs. It can even draw graphs in several coordinate systems on the same screen or page. Version 1.1 lacks control over line thickness or symbol size, as well as filled symbols. Version 2.0 promises to correct the program's few failings. Not copy protected.

CIRCLE **636** ON READER SERVICE CARD

SDS

SDS, $995 from dpms, is designed to take an irregular array of data-point triplets (x,y,z) and generate a regular mesh (grid) of real and interpolated z values at each grid point. It can then do one of three things: plot a contour map; plot a solid, filled, and colored contour map; or plot a three-dimensional, wire-mesh depiction of the z values using the Kriging algorithm to do the gridding.

The program can import ASCII data files in various formats, but the user has to add a simple header at the top. One of the program's most useful features is its capability to overlay maps on top of a surface plot. A geologist, for example, could plot



SDS (tm) Surface Display System by DPMS - Kirkland, WA
Groundwater Surface Map from USGS 3D Model

SDS can create a true 3-D perspective, complete with overlying contour lines.

the concentration of radon gas across the map of Massachusetts, or a neurophysiologist could superimpose a plot of brain activity over a sketch of the brain surface.

This is not a program for the faint-hearted. *SDS* is a big program, brimming with useful features. This industrial-strength program produces terrific-looking output, but you have to read the manual.

SDS is a command-driven system. You type variables on the command line, followed by their new values. The program requires that you do a fair amount of typing, and it has only minimal editing capabilities: if you want to make a small change to a previously typed line, you'll need to retype the entire line. At the very least it would be nice to have a "Plot" key that always plots to the screen. It's common to make many changes to the plotting parameters; every time you do this, you have to type the word "plot" to see the effects of your changes.

Installation was a near-nightmare. Technical support was very helpful and knowedgeable, but the technical support representative we spoke with said that most users need help with the installation. Sounds like the time has come for a better INSTALL program, doesn't it? Once you've installed the program and have read the manual, all (well, almost all) is well.

SDS manages to cram a lot of information onto the screen, so most of the plot parameters are always available. However, this is accomplished at the expense of clarity, since some of the parameter names are not self-explanatory. And the program lacks a help system, so it's time to turn to the manual again.

In terms of features, there is little this program lacks. Most noticeably, there does not seem to be a way to plot axes in a 3-D surface plot, as *Surfer* lets you do. This feature is nice to have—and sometimes necessary.

It's altogether too easy to lose your work. First of all, the program doesn't request confirmation before quitting. If you make a mistake that sends the program into a tailspin and try to recover by hitting Esc several times, you will come right out of the program, losing your work. We also managed to crash the system when we tried to type ahead while the program was preparing to plot. A solution to this problem would be to turn off the keyboard interrupt if it can't handle such situations: there is nothing worse than losing a lot of work because situations like these are not accounted for.

SDS is not a very loveable program, simply because the user interface is demanding and somewhat arcane. An improved user interface would be a great help. However, feature for feature, there is nothing else like *SDS*. And if you need these features, as we do, you have to bear it.—**Ehud Kaplan**

FACT FILE

***SDS*, Version 2.12**
Design Professionals Management Systems (dpms)
610 Market St., #103
P.O. Box 2364
Kirkland, WA 98083
(206) 682-1772
List Price: $995
Requires: 512K RAM, DOS 3.0 or later.
In Short: *SDS* (*Surface Drawing System*) is a powerful program with many useful features, some of which are unique to this software (such as filled contour plots). Installation is difficult, the user interface is somewhat arcane, and the program doesn't give you enough control over labeling the plots: it lacks fonts and doesn't allow you to position the labels. Not copy protected.

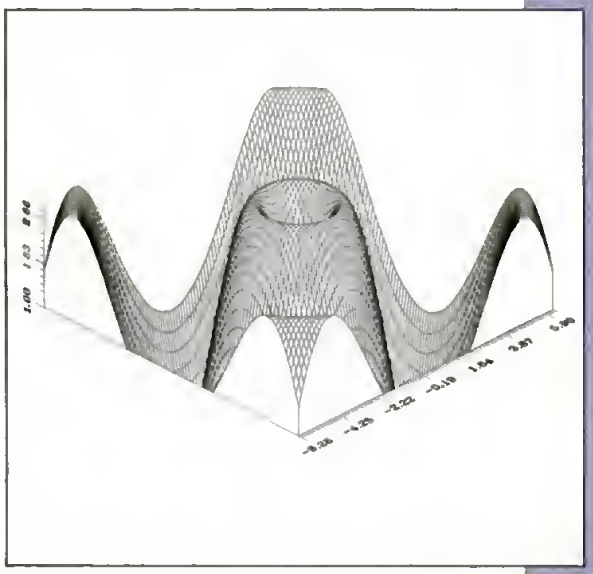
CIRCLE 635 ON READER SERVICE CARD

Surfer

Surfer, $499, is Golden Software's three-dimensional surface-plotting program. The user interface is similar to *Grapher*'s, but it is better in one important respect: you can edit the parameters of the plots simply by moving a cursor to them and editing them in place.

Surfer consists of three related modules: Grid, Topo, and Surf (which can also be used independently), and the same View and Plot modules that are supplied with *Grapher*. The package is outfitted with an access system that allows easy transfer of data files between the separate modules.

The Grid module is used to convert an irregular collection of *x,y,z* triplets, which represent the data, into a regular mesh of *x,y,z* values. *Surfer* supplies two interpola-



Surfer lets you create 3-D wire-mesh depictions of gridded data to which you can add axes and scales.

tion algorithms—inverse distance and Kriging—to interpolate the values between the data points.

Since the Grid module can produce gridded data in simple ASCII output files, the files can be used by other graphics programs. This module also includes a simple spreadsheet to allow manual data entry and some data manipulation. One of this module's particularly nice features is its ability to grid two-dimensional mathematical functions.

The Topo module is used to create contour plots from the gridded data created by Grid. However, Topo need not rely solely on the Grid module for its data. Since it accepts ASCII input files, it could plot contours from gridded data produced by any other program as long as the data conformed to the required format.

Topo lets you choose from two types of contours: labeled and unlabeled. You can also choose whether the contour intervals will be regular, irregular, or logarithmic. Like *Grapher*, Topo allows almost unlimited freedom in improving the appearance of the plot: fonts for labels and titles (16 character sets), arbitrary size for the plot and its label, almost complete control over the color of every element of the graph, and so on.

The Surf module is designed to produce the 3-D wire-mesh depictions of the gridded data. This module is every bit as flexible and easy to use as *Grapher*. You can tilt, rotate, change colors, add axes, label beautifully, add a base, scale—in short, it's hard to think of what you can't do. However, *Graftool* does give you more-flexible rotation capabilities, such as rotation around *x*- or *y*-axes.

Surfer lets you plot any combination of the three possible contours: you can plot only *x*, only *y*, only *z*; or you can plot *x* and *y*, *x* and *z*, *y* and *z*; or *x*, *y*, and *z* together. It would be nice if you could name the color for each contour, as is possible with *SDS*; that way you can draw the wire mesh in, say, blue, and the isoelevation contours in yellow, for a really nice display.

Surfer does have a few minor limitations. For example, it would be useful to make stick plots, in which the height of the stick is the *z* value and the interpolated surface is not drawn. And the program was somewhat slow to plot on an HP LaserJet: plotting sin(r)/r at 100 by 100 points took about 10 minutes, and the program doesn't indicate how far along it is in the plotting process. *Grapher*'s method of reporting which "record" is being processed at any moment would be nice here.

—Ehud Kaplan

Ehud Kaplan, Ph.D., is an associate professor of Biophysics at The Rockefeller University in New York City, where he does research in neurophysiology.
David P. Edwards is a Ph. D. candidate in Visual Neuroscience at The Rockefeller University.

PC MAGAZINE FACT FILE

Surfer
Golden Software Inc.
807 14th St.
P.O. Box 281
Golden, CO 80402
(303) 279-1021
(800) 333-1021
List Price: $499
Requires: 256K RAM, DOS 2.0 or later.
In Short: *Surfer* consists of three useful programs: Grid, to produce a regular *x,y,z* mesh from irregular *x,y,z* triplets; Topo, to draw contour plots from the mesh produced by Grid (Topo does not produce filled contour plots); and Surf, to draw the 3-D representation (surface) from the output of Grid. The package is easy to use and produces stunning-looking output. Not copy protected.

CIRCLE 634 ON READER SERVICE CARD

PC MAGAZINE EDITOR'S CHOICE

- SDS
- Surfer

Surfer *wins for ease of use, but* SDS *has more features, such as filled contour maps. If you need the features offered by* SDS, *you are probably a power user, and this program is for you.*

Graftool—*supporting both 2-D and 3-D graphs at the same time—is a promising program. The current incarnation, Version 1.1, still has too many shortcomings to be recommended, but the next version, 2.0, will be an important product in this market.*

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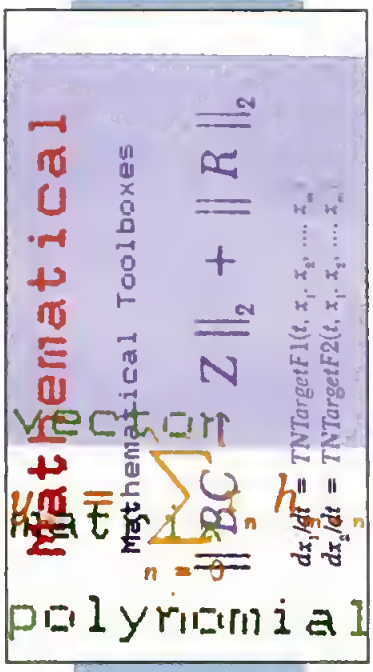
BETTER TOOLS FOR HIGHER MATH

WHEN NUMBERS COUNT



Today's mathematical application software packs mainframe power into your PC.

In 1928 D. Hartree, a researcher at Oxford, developed what is still the standard method for computing the energies of atoms. Hartree was very fortunate in that his father had retired from a civil service job the year before and was available to man an adding machine 8 hours a day. Now that computers have revolutionized the way science is done, scientists and engineers can accomplish much more complex calculations than Hartree's—and without disturbing their parents' golden years.

Ten years ago machine-driven scientific calculation was neatly split into two: serious number crunching on a mainframe and simple calculations on a hand-held calculator. The PC has filled in the middle ground, and the mathematical packages we review here span the gamut from the low end to the high. We have divided the programs into two classes that we reviewed in separate groups: ten nonprogrammable toolboxes that are intended more for calculating and modeling, and six programmable toolboxes (actually full-fledged mathematical languages). These programs are invaluable for natural scientists and engineers, as well as some social scientists, programmers, and financial model builders.

The six programmable toolboxes—*Asyst*, *Curve*, *Gauss*, *MathGraf*, *Matlab*, and *TK! Solver Plus*—give you the kind of power a mainframe had 10 years ago. Indeed, *MathGraf* and *Matlab* have been ported from the minicomputer environment where they were first developed. The problems that you'd approach with these packages are the kind that you might write a custom program for in APL, FORTRAN, or C. These packages offer mathematical objects and functions as built-in primitives (unlike conventional languages), so it's usually easier and quicker to write mathematical routines with these programs than in a conventional language.

Although standard C or FORTRAN libraries don't have mathematical functions, specialized libraries are available if you want to work that way. An attractive collection of tools called *Mathpak 87* is avail-

able from Precision Plus Software (1239 Sir David Drive, Oakville, Ontario, Canada L6J 6Y9; (416) 829-1511). Precision Plus offers versions for Turbo Pascal, Modula-2 (Logitech and ITC), FORTRAN (Microsoft, Lahey, and IBM), and C (Microsoft and Lattice). While the routines are set up to be called from a high-order language, they are written in 80*x*86 and 80*x*87 assembly language.

Besides low-level routines like swapping vectors, *Mathpak 87* includes such high-order routines as matrix inversion, three methods for solving nonlinear equations, eigenvalue routines, least squares fit, fast Fourier transforms, numerical integration, and two ordinary differential equation solvers.

APL is an ideal tool for some kinds of mathematical questions. APL was originally developed almost 30 years ago by a mathematician as a mathematical notation and was implemented as a programming language only in the mid '60s. It shows its history by being stronger in its notational aspects than in its programming aspects. The central dogma of the notation is to be uniform among operations, so there are no separate symbols for sum and product. Rather, the slash is used to indicate a repeated operation on a vector.

The downside of APL's elegant notation is that there are many special symbols that do not appear in the standard IBM/ASCII set. You'll need a special character ROM on most monochrome adapters, and downloadable fonts on an EGA or VGA (supplied by many APL vendors), or you'll run in graphics mode on a CGA.

The language was originally developed at IBM, which still dominates the mainframe APL market and has a spiffy new APL2/PC for the PC. However, STSC (2115 E. Jefferson Street, Rockville, MD 20852; (301) 984-5000) has been the standard supplier for the PC market with *APL *Plus;* it's now on Version 8.0. STSC has recently introduced an 80386 version *APL *Plus II*, with support for nested arrays, more speed, and access to more than 640K through Phar Lap's *386/DOS-Extender*. For learning purposes, there is a free APL intepreter called IAPL with limitations and speed problems, it can be downloaded from PC MagNet.

With the exception of *Curve*, all the programmable math toolboxes we review here are aimed toward getting numerical output rather than concrete analytical formulas. They'll deal with finding the numerical solution of an explicit quadratic equation rather than the general algebraic formula for solving any such equation. While *Curve* will find numerical solutions, you can access the power series expansion on which it is based.

SYMBOLIC MANIPULATION Manipulating algebraic formulas on a computer is known as symbolic manipulation. While *Curve* is certainly not a symbolic manipulation program, it has a little of the flavor. Microsoft distributes a symbolic manipulation program called *muMath* that we have not included in this review because of the major new products expected in this area (see the sidebar "Mathematica: Hype or Hope?").

Among the packages that we have placed in the nonprogrammable math toolbox category, there is a spread of some programming capability. In particular, *Formula/One* and *SolveIT* offer quite sophisticated programming, although we can't imagine using them for the type of model that you'd need to run overnight.

The ten programs in this category have such different features that some comparisons would be of the apples/oranges type. *IAS* does almost everything you'd want except for equation solving, while *Eureka* does little besides equation solving; the overlap is in their graphing capability. An eleventh program in this category, *SolverQ* (Scientific Logics, 21910 Alcazar Ave., Cupertino, CA 95014; (408) 446-3575), was not reviewed because it was undergoing an extensive upgrade when this article was being prepared.

What should one look for in a mathematical toolbox? That, of course, depends on your needs. You may care about curve fitting or statistical functions. You may care about whether the program will handle complex numbers. But you'll probably want a wide array of built-in functions, as well as the possibility of defining your own procedures.

A picture can be invaluable in analyzing models, so graphing capabilities are important. Can you graph multiple functions on one set of axes? Can you use logarithmic scales? How about parametric functions and three-dimensional surfaces?

Output of the graphs is also important. Unfortunately, some of these programs limit hard-copy output to what you can get with the PrtSc key, assuming you have a driver to send graphics mode to your printer. Others produce magnificent output on LaserJets or PostScript printers. One kind of output that has been ignored by most vendors is a standard disk-based graphics format. With such a feature, you could make a plot of a function and later import it into a desktop publishing program or technical word processor. Of all the products reviewed here, only *Asyst*, *IAS*, *Gauss*, *MathGraf*, and *Matlab* have this kind of support (typically in only one format).

Another crucial aspect of these programs is the user interface. With a word processor, the most fundamental interface is the standard of typing in text. There is nothing like that kind of core in the programs under discussion here. You might think that all of the programs would let you enter a polynomial definition like

$$P(x) = x^3 - x^2 - x - 1$$

using the typewriter keys. But *IAS* and *SolveIT* use alternative methods. Since their methods may be to your liking, the reviews describe how they work in some detail. *MathCAD*'s WYSIWYG interface is also unique—you enter an equation and it appears on the screen just as you'd see it on a sheet of paper. For example, if you type in "x^3", it appears on the screen as x^3.

But there is a lot more to the interface than function entry. Too often these programs are overly complicated, as if their methods existed to make the programmers' lives easier rather than the users'. With the metaphor of a spreadsheet one of the most common in the PC universe, you'd think each of these programs would allow you to edit a matrix as if it were a spreadsheet. But several do not: for example, *Gauss* has a matrix editor that lists all elements in a single column.

Considering what these programs are capable of, only *Asyst* can be classed as expensive. Several stand out as giving a particularly large bang for your bucks. *SolveIT*, *The Professional Wheel*, and *The Scientific Wheel* among the nonprogram-

MATHEMATICA: HYPE OR HOPE?

A review of mathematical software for the PC wouldn't be complete without mentioning that a new package called *Mathematica*, from Wolfram Research, is expected to be available for IBM and compatible machines by the time this article appears in print. The product has been available for Macs (equipped with at least 2MB of memory) for some months now.

The software has been the focus of a lot of attention since it was first announced at a press conference held by Wolfram in Santa Clara during the spring of 1988. The conference was attended both by Steve Jobs, who announced his intention to bundle a version of the software with his futuristic NeXT machines, and Bill Joy of Sun Microsystems, who plans to offer a version of *Mathematica* for the company's workstations. The fanfare that began then has continued through a series of breathless articles appearing in publications as varied as *PC Computing* and *Notices of the American Mathematical Society*. It has gotten so extreme that the CEO of a Big 10 software firm, known as a master of publicity in the PC community, commented that he'd never seen a product being hyped so much.

However, behind all that extravagant publicity lies a product of seemingly real merit. *Mathematica*, in all its versions, possesses a number of abilities that should excite mathematicians, scientists, and engineers alike, including

- provision for exact calculation with integers, even those with many digits
- the ability to factor large numbers
- an enormous array of special functions, even in the complex domain: hypergeometric functions, zeta functions, and elliptic integral functions are all available
- outstanding graphics
- symbolic manipulation to allow exact algebraic calculation of integrals and derivatives, as well as simplification of algebraic expressions
- the ability to translate a mathematical expression resulting from a *Mathematica* calculation into the print formatting language, TeX
- support for third-party packages—programs for teaching calculus, statistical analysis, and symbolic solutions of differential equations are already planned and await implementation.

Mathematica on the PC will use display PostScript for its on-screen graphs; an included utility lets you translate your graphics into .EPS files for importation into desktop publishing programs. Besides support for PostScript printers, special drivers for popular printers like the HP LaserJet will be included.

PC users anxiously awaiting the arrival of the well-promoted and promising software should stock up on the essentials now. That means a 386 machine, preferably with 4MB of memory. However, the program is expected to run on machines with as little as 1.5MB of RAM if there is 3MB of disk space free for virtual memory. *Mathematica*, which will come with Phar Lap's *386/DOS-Extender* to access extended memory, will be available in three separate versions: one for machines with no coprocessor, one for those with an 80387 or 80287, and one for those with a Weitek coprocessor.

STIFF COMPETITION Although *Mathematica* is riding high now, by the end of the year it may have serious competition. *Macsyma* is a symbolic manipulation program developed at MIT, and its abilities in this area are clearly beyond what *Mathematica* currently offers. Symbolics (8 New England Executive Park, Burlington, MA 01803; (617) 221-1000), publisher of the mainframe and minicomputer versions of the program, plans a PC version that will require a 386 machine with 8 to 12MB of RAM.

If you're interested in finding out more about *Mathematica*, you can pick up a copy of *Mathematica—A System for Doing Mathematics by Computer* (published by Addison Wesley: softcover, $29.95; hardcover, $44.25; ISBN 0-201-19334-5; available from Addison Wesley, (415) 594-4444, and Wolfram Research, (217) 398-0700). The 750-page book also serves as part of the program's documentation.—**Barry Simon**

mable tools; *Curve*, *Gauss*, and *TK! Solver Plus* among the programming languages.

TOWARD THE FUTURE During the next year, the complexion of the math toolbox market will change in significant ways. To see why, it is important to understand the limitations of the current PC environment. First, the 640K barrier is a very real one for these programs. The myriad functions that some of these programs have is code intensive. Some get around this problem by putting many of their functions into separate files that are invoked only as needed. With the more powerful programs, it is inevitable that you will get an occasional "out of memory" error when you try to do something complicated. The memory issue would be helped if the programs made use of EMS memory, but so far only *MathCAD*, *Asystant*, and *Asyst* do.

A second hardware issue concerns the 64K sector size intrinsic to 8086 and 80286 chips. Since IEEE reals take 8 bytes, 64K can fit a matrix that is roughly 90 by 90. Double-precision complex matrices are limited to 45 by 45. It is possible to write programs that manipulate objects over 64K (for example, STSC APL has matrices limited only by available memory), but it is more complex, and none of the programs we reviewed allow such objects with their ordinary versions.

New PC operating systems and hard-

USING YOUR SPREADSHEET AS A MATH TOOLBOX

Math toolboxes offer more graphics and functions, but Lotus and the other popular spreadsheets can do it as easy as 1-2-3.

Electronic spreadsheet programs can often be used as replacements for the mathematical toolboxes reviewed in this article. They are powerful programming languages laid out in a form that permits extremely rapid problem solving: their work areas are easy to read and easy to change, and the interconnecting webs of values and formulas stretch out before the user just as they would on a pad of paper, making the issues at hand clear and the refinements easy to implement. Even when one of the math toolboxes discussed in the article is more appropriate for handling the "real" work, the structure and power of the spreadsheet often recommend its use as a scratch pad to build prototype solutions.

Lotus 1-2-3 and the like are often the tools of choice when numerous alternative scenarios must be explored. They are especially powerful environments in which to build small simulations of physical, financial, or other processes. Suppose, for example, that you wish to follow the change of some property with time (position, chemical concentration, cash flow, and so on) and that you have a mathematical expression that describes the rate of change of this property as a function of one or more attributes. If the first row of a spreadsheet array is used to define the starting conditions, each subsequent row of the array can be used to calculate future conditions very shortly thereafter. A large number of such rows can be used to predict the future; numerous alternative futures can be explored by simply altering the starting conditions or the rate of change over time.

Spreadsheets are enhanced by built-in formulas capable of calculating a large number of logical, transcendental, statistical, text-manipulation, and financial functions. Standard numerical methods such as integration by Simpson's rule or solutions to differential equations via Runge-Kutta can be efficiently implemented using spreadsheet programs.

Most spreadsheets offer graphics such as histograms, line charts, area charts, scatter charts, and pie charts; these graphics can be linked to the models that produce them so that they change instantly as alternative scenarios are explored. In some respects, graphics capabilities are limited—for instance, the plotting of 3-D surfaces is not in the repertoire of most spreadsheets. Progress is being made in a few areas, though; while some programs are still very limited in terms of the number of data points that can be plotted, others have remedied this situation. Aesthetically, market leader *1-2-3* still suffers from poor graphics, but products like *Excel* have moved ahead to offer more attractive graphical displays.

The wide range of features that are available may make it worth your while to look through your spreadsheet manual before springing for a math toolbox. Your old faithful *1-2-3* could be all you need. Even if it is not, it could prove a valuable adjunct to any of the programs that are reviewed in the article.

—David S. Barkley

David S. Barkley is the president of Bellerophon Books in Santa Barbara, California. Bellerophon will shortly publish a series of college-level workbooks in physics, chemistry, and biochemistry to exploit the electronic spreadsheet as a tool for calculation and simulation.

ware handle both these problems. OS/2 allows you to address larger memory blocks, and 80386-based computers deal with both issues. Intrinsic sector size for 80386 native mode is a full 4 gigabytes, so variable size is limited only by memory and disk space. DOS extenders, most notably the one from Phar Lap, allow DOS to run programs in protected mode with access to memory above 1MB. Mathworks already sells a version of *Matlab* that uses the Phar Lap DOS extenders. And Aptech Systems has a 386 version of *Gauss* that differs from the standard version in the processor instruction set used rather than in memory usage. A full-fledged 386 version of *Gauss* is expected out this year.

The extra memory that the 386 can manage will make it possible to port symbolic manipulation packages from minicomputers to the DOS environment. In particular, two products, *Macsyma* and *Mathematica*, should dramatically change what you can do mathematically on a PC (see the sidebar "Mathematica: Hype or Hope?").

A math coprocessor is an important adjunct to using many of the mathematics toolboxes that we discuss. Most support math coprocessors and some require one. Typically, a math coprocessor will speed up mathematics-intensive computing by a factor of 2 to 4. 8087s have a street price under $200, and even 25-MHz 80387s have street prices under $1,000. Math coprocessors are an essential investment for a scientist or an engineer. Some 80386-based manufacturers allow slots for another coprocessor made by Weitek.

THE WEITEK ADVANTAGE Weitek supplies high-performance numeric components to workstation manufacturers such as Apollo and Sun. Over a year ago Compaq included a Weitek socket in its Desk-

pro 80386/20. The Weitek socket, which is now a standard component on many 80386 machines, allows both an 80387 and a Weitek w1167 coprocessor, an 11-chip board with a floating-point multiplier and accumulator, to run on the same machine. Weitek has recently made available the w3167, a single-chip device that is available in 20- and 25-MHz versions. Among the personal computer manufacturers with machines that support one of the Weitek coprocessors are ALR, AT&T, Acer, Compaq, Hewlett-Packard, NCR, Northgate, Olivetti, and Tandy.

The w1167 and w3167 enhance overall throughput by 50 to 300 percent—depending on the application—over the 80387. In general, scalar and single-precision operations see the largest benefit, while vector and double-precision operations see the least. The w1167 is a tremendous asset to real-time graphics, which usually requires only single precision. Long-running vector programs typically execute 70 to 100 percent faster, depending on the sophistication of the compiler used to generate the application.

The w1167 and w3167 are available from Compaq or Microway (Microway, P.O. Box 79, Kingston, MA 02364; (508) 746-7341) for the Deskpro series. Microway also produces a number of special w1167 cards for other popular 386 machines, including an MCA card for the IBM PS/2 Models 70 and 80.

Because Weitek support is far from universal, you'll probably want an 80387 in addition to a Weitek, so the investment will be considerable. Is it worth it? If you do a lot of number crunching or interfacing of programs that support the chip, that factor of two is very significant. If you use a math package only occasionally, perhaps not. Of the products reviewed, only *Matlab* has a Weitek version. But it is significant that Wolfram Research expects to have a version of *Mathematica* that supports the Weitek coprocessor.

You can already do a lot of serious mathematics on a personal computer with the products we review here. The thought of what we will be able to do with multimegabyte 80386 machines with powerful coprocessors and the next generation of enhanced mathematical applications makes my mouth water.

NON-PROGRAMMABLE TOOLBOXES

Asystant

Beyond simple calculations, there are two analytical tasks that scientists and engineers want to do on a PC: analysis of functions and data analysis. Asyst Software Technologies' $495 *Asystant*, like its big brother, *Asyst*, takes the data analysis half of its task especially seriously. With Version 1.10 you can graph the data, do statistical or Fourier analysis, a variety of curve fits, or even analyze the effect of adding random noise to the data. Advanced versions of the product are available with direct links (though not as many as are found in *Asyst*) to data-acquisition hardware.

What separates *Asystant* from the $1,695-and-up *Asyst* is its lack of an extensive programming language. The only programming you can do is set the function keys to define functions as sequences of its basic commands (macros); there isn't even a simple "if" construction.

The center of the program is its desktop calculator, a reverse Polish calculator with a 5-element stack and 18 memories, 9 of which can hold one- or two-dimensional arrays. You can enter one of more than over 100 calculator functions via four menus that you cycle through. You can also enter functions via a command line, which takes reverse Polish notation, or enter algebraic notation by beginning the expression with a backslash. The program keeps a stack of previous commands and expressions that you can access and edit.

You can graph, integrate, or otherwise manipulate a function, but you must first place the values at discrete points into an array. Because of the program's limited tools, this can be a tedious task if your function is complicated.

The program does have a wide variety of special functions: not only the usual ones, but even elliptic functions and a variety of special polynomials. You can integrate single functions or numerically solve systems of ordinary differential equations. The program also understands matrices and complex numbers. Its biggest weakness is equation solving: it can solve sets of linear equations and polynomials in only one variable.

The graphing module is extensive. You can plot in four windows, and graphs can include parametrically defined functions, three-dimensional plots, and contour cross-sections of a function of two variables. This excellent module is marred by the fact that the only hard-copy output devices fully supported are plotters.

Asystant's interface is less than ideal: there are menus with as many as 30

FACT FILE

***Asystant*, Version 1.10**
Asyst Software Technologies
100 Corporate Woods
Rochester, NY 14623
(716) 272-0070
List Price: $495; versions with links to various data acquisition boards: $695 (*Asystant GPIB*) and $995 (*Asystant Plus*). Upgrade from Version 1.0: $50 for *Asystant*, $100 for *Asystant Plus*.
Requires: 512K RAM (640K recommended), math coprocessor, graphics card, DOS 2.0 or later. *Asystant Plus* requires 640K RAM; parallel port required for *Asystant GPIB* and *Asystant Plus*.
In Short: *Asystant* has superb graphics and fine data analysis tools, along with limited tools for analyzing functions. *Asystant* is not copy protected; *Asystant GPIB* and *Asystant Plus* are copy protected with parallel port block.

CIRCLE 623 ON READER SERVICE CARD

Mathematical Toolboxes: Summary of Features

(Products listed in ascending price order within category)

	NONPROGRAMMABLE						
GENERAL PROGRAM FACILITIES	The Scientific Wheel $69	Tekcalc $95	The Professional Wheel $99	SolveIT $129	Eureka $167	Formula/One $200	IAS $249
Data import and export							
Imports/exports ASCII	○/○	●●	○/○	●●	○/○	●●	●●
Imports .DIF files	○	●	○	●	○	○	●
Imports Lotus 1-2-3 files	○	○	○	○	○	●	○
Internal format (commands and data) saved and restored	○	●	●	●	● (Commands only)	●	● (Data only)
Programming constructs	○	○	○	●	○	●	○
Menus	○	●	●	●	●	●	●
Command line	●	○	●	○	○	○	●
Context-sensitive help	○	○	○	○	●	●	○
External languages supported	None	None	None	None	None	None	BASIC, C, FORTRAN
Built-in editor	●	●	●	●	●	●	○
Built-in matrix editor	○	○	○	○	○	○	●
Shell to DOS	○	○	●	○	●	●	●
Directory list at filename prompt	○	○	●	○	●	●	○
"Unsaved data" warning	●	○	●	●	●	●	●
Hardware support							
Math coprocessor support	○	●	○	●	●	●	●
EGA support	●	○	●	○	●	●	●
Mouse support	○	○	○	●	○	●	●
Minimum disk space required	320K	185K	525K	720K	200K	395K	2.6MB
Maximum disk space required	320K	400K	525K	790K	260K	680K	2.8MB
DATA TYPES							
Complex numbers	○	●	○	●	●	○	●
Variables	●	○	●	●	●	●	●
User-named variables	●	○	●	○	●	●	○
Array dimensions	N/A	N/A	N/A	N/A	N/A	1	2
Unit conversions	●	○	●	○	●	●	○
FUNCTIONS							
User-definable	●	●	●	●	●	●	●
Bessel	○	○	○	●	○	○	●
FFT	○	○	○	○	○	○	●
Statistical	○	●	●	●	●	●	●
Curve fits	○	●	●	○	○	●	●
Summations	○	○	○	○	○	●	●
Matrices: product, det, inverse	○	○	○	○	○	○	●
Eigen values	○	○	○	○	○	○	●
Derivatives	●	○	○	●	●	●	●
Integrals	●	○	○	●	●	●	●
Differential equations	○	○	○	●	○	○	●
Equation solving							
Polynomials, real roots	●	●	○	●	●	●	○
Polynomials: complex roots	○	○	○	○	●	○	○
Functions of one variable	●	○	○	●	●	●	○
Simultaneous nonlinear equations	○	○	○	○	●	●	○
GRAPHS							
2-D	●	●	○	●	●	●	●
Log scales	○	○	○	○	○	●	●
Parametric function	○	●	○	○	○	●	●
3-D and contour	○	○	○	○	○	○	○
OUTPUT							
Dot matrix printers	●	●	●	●	●	●	●
Laser printers	●	○	●	○	○	●	●
Plotters	○	○	○	○	○	○	●

—Editor's Choice ●—Yes ○—No N/A—Not applicable this product does not handle arrays

All of the mathematical toolboxes we reviewed have certain features in common, including logarithmic, exponential, and trigonometric functions. Each of the programmable toolboxes uses a proprietary programming language, while some "nonprogrammable" packages do have simple programming constructs. The table shows which additional features are found in each package.

Note that, as a rule, toolboxes that import ASCII files can also export files in this format. By contrast, the ability to import .DIF or *Lotus 1-2-3* files is normally not coupled with export capability.

PROGRAMMABLE

Point Five $295	MathCAD $349	Asystant $495	Curve $99	Gauss $395	TK! Solver Plus $395	MathGraf $695	Mntnb $695	Asyst $1,695
●/●	●/●	●/●	●/●	●/●	●/●	●/●	●/●	●/●
●	○	●	○	○	●	○	●	●
○	○	○	○	○	●	○	○	●
●	●	●	●	●	●	● (Data only)	●	●
●	●	● (*GPIB* only)	●	●	●	●	●	●
○	●	●	○	○	●	●	○	●
●	●	●	●	●	○	●	●	●
○	○	●	●	●	●	○	●	●
None	None	None	None	Assembler, C, FORTRAN	None	None	C, FORTRAN	Assembler
●	●	●	○	●	●	○	○	●
●	●	●	○	●	○	○	○	●
○	●	○	○	●	○	●	●	○
○	●	○	○	○	●	●	○	○
●	●	●	●	○	●	○	○	○
●	●	●	●	●	●	●	●	●
○	●	●	●	●	●	●	●	●
○	○	○	○	○	○	○	○	○
310K	350K	630K	350K	1.0MB	280K	400K	530K	720K
310K	520K	990K	1MB	2.3MB	1.4MB	880K	1.1MB	1.5MB
○	●	●	○	●	●	●	●	●
●	●	●	●	●	●	●	●	●
●	●	○	●	●	●	○	●	●
2	2	2	1	2	Unlimited	2	2	16
○	●	○	○	○	●	○	○	○
○	●	●	●	●	●	●	●	●
○	●	●	●	●	●	●	●	●
○	●	●	○	●	●	●	●	●
●	●	●	○	●	●	●	●	●
●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●
●	●	●	○	●	●	●	●	●
○	Optional ($55)	○	○	●	●	●	●	●
○	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●
○	Optional ($55)	●	●	○	●	●	●	●
○	●	●	●	●	●	●	●	●
○	●	●	●	●	●	○	●	●
○	●	○	●	●	●	●	●	●
○	●	○	○	●	●	○	○	○
●	●	●	●	●	●	●	●	●
○	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●
○	○	●	○	●	●	●	●	●
●	●	●	●	●	●	●	●	●
●	●	●	○	●	○	PostScript only	●	●
○	●	●	○	●	○	●	○	●

choices, and you must pick from them using arrow keys rather than simply typing in the option's initial letter. I suppose that I could get used to pressing "?" to get help, Alt-F10 to exit, and even Esc to indicate acceptance of a current choice—if they were used consistently. Instead there is a hodgepodge of inconsistencies. For example, there is no on-screen prompt to tell you how to exit from the array editor, and neither Alt-F10 nor Esc could get me out. It was only when I hit ? to get help that I was able to exit from the editor.

Support is free (but not toll-free) for only 60 days, as compared with the unlimited toll-free support that *MathCAD* and *TK! Solver Plus* give you.

If your primary need is data analysis and you don't need the programmability of *Asyst* (and if you're willing to put up with the program's fickleness), then *Asystant* is worthy of your consideration.

Eureka

If you've ever used Turbo C or one of the recent versions of Turbo Pascal, you'll feel right at home with Borland's $167 *Eureka*. You define a problem using a built-in editor with the standard Borland/*WordStar* interface, hit Esc to access the bar menu, and choose Compile—I mean Solve—from that menu. If there is a syntax error, you'll be thrown into the editor with the cursor at the offending point. The various program modules can be windowed on the screen.

Version 1.0's equation file consists of a set of equations for up to about 10 real variables (the manual claims 20, but numerical errors become severe around 10 or 11) or 6 complex variables. Equations can include one of several built-in functions or your own user-defined functions. Some of the "equations" can be inequalities, and you can ask to maximize certain quantities. Usually, you'll need to specify initial guesses, and by varying these initial guesses, you can find multiple solutions. After running the Solve command, a few keystrokes will bring up a box that lets you test the solutions by substituting them back into the equations. Or you can invoke a report module with the equations and solutions already filled in.

Though *Eureka* does a creditable job of equation solving, it does little else. It will compute integrals of one variable and numerical derivatives. It will graph functions, but only of a single variable and no more than one function at a time. It will display lovely graphs at EGA resolution; if you don't have a graphics monitor, it will display a plus-sign character-based graph. But it has no matrix support, no multiple integrals, and no log scales, and its sums tend to die at about 100 terms compared with thousands for many other programs. It has limited statistics and no curve fitting or data analysis. Its built-in calculator is a joke, although you can do most serious calculation by setting the answer to an unknown in the editor and solving for that unknown.

Eureka has the slick and easy-to-use interface that we have come to expect from Borland. But unless your needs are limited strictly to solving equations with ten or fewer unknowns, you should look elsewhere.

FACT FILE

***Eureka*, Version 1.0**
Borland International
1800 Green Hills Rd.
P.O. Box 660001
Scotts Valley, CA 95066
(408) 438-8400
List Price: $167
Requires: 384K RAM, DOS 2.0 or later. Math coprocessor optional.
In Short: *Eureka* is a lovely program for solving equations, but otherwise it's very limited. Not copy protected.

CIRCLE 621 ON READER SERVICE CARD

Formula/One

If imitation is the sincerest form of flattery, then MathTec, the maker of *Formula/One*, must really like *TK! Solver Plus*. Though the programs do not share the same command keys, the basic structure of *Formula/One*, Version 2.0A, as well as its on-screen design, is very similar to that of *TK! Solver Plus*. In imitating these features, MathTec was only showing good business sense: when the $200 *Formula/One* software was introduced, *TK! Solver Plus* was the leading math toolbox on the market.

FACT FILE

***Formula/One*,**
Version 2.0A
MathTec, Inc.
43 South Main St.
Newton, NH 03865
(603) 382-7301
List Price: $200
Requires: 384K RAM, DOS 2.1 or later.
In Short: A *TK! Solver Plus* clone with better printer support and a spiffier menu, it shares *TK! Solver Plus*'s solid equation solving and complex interface for advanced uses. Not copy protected.

CIRCLE 620 ON READER SERVICE CARD

The similarity between the two is so strong that the description of *Formula/One*'s user interface to the solver engine could just as well describe that of *TK! Solver Plus*. The screen is divided horizontally into two windows—one that defaults to an equation sheet, the other to a variable sheet. The link between the two is elegant: if you type an equality into the equation window, any variables not already included in the variable sheet are automatically added to it. After entering all the equations, you hit a key to attempt to solve the model. If you don't succeed, it may be necessary to switch to the variable sheet and enter initial guesses for some variables.

While that's simple enough, anything more complex than this can get quite involved. For example, to plot a parametric equation, you would first enter x and y as functions of the parameter, which we'll call t. Next, switch to the variable sheet, place the cursor on the t row and enter IL (for input list) in the status column, then hit F3 to "dive" into the list. *Formula/One* defaults to only 10 elements per list, so you'll need to change the number of elements to a larger figure like 500. Hitting Ctrl-F invokes a dialog that fills the input

list with equispaced points. After escaping out of the dive, you'll have to indicate that x and y are output lists and then dive into them to indicate that they should also have 500 points. Choosing the Solve key then fills the x and y lists with their values as t varies. You must then invoke your sixth window: the graph sheet where you enter the variables to be graphed and their ranges. Finally, press F10 to display the graph. Compare that with the simple procedure described in the *MathCAD* review!

In *Formula/One*'s (and *TK! Solver Plus*'s) defense, it should be pointed out that while this is complicated, it isn't much harder to deal with a situation where x and y are only implicit equations of t—that is, given by solving $f(x,t)=0$. Out of all the programs we reviewed, only *Formula/One* and *TK! Solver Plus* can handle such a problem relatively easily.

Formula/One has a few enhancements over *TK! Solver Plus*: its pull-down menus are slick, and it has lovely mouse support. And unlike *TK! Solver Plus*, it supports laser printers. In other respects, though, it cannot compare with *TK! Solver Plus*. While *Formula/One* does have several sophisticated language constructs, it does not have real subroutines and so cannot be considered to have a full-fledged programming language. *TK! Solver Plus* comes with more than 100 on-disk functions and models compared with the 21 found in *Formula/One*—all of a tutorial nature. And while its solver is strong, *Formula/One* is missing support for complex numbers (expected in the next release), differential equations, and matrices, all of which are available in *TK! Solver Plus*. The lower price of *Formula/One* may make it attractive to users who don't need these features, but they should be aware that the package is less extensive and less powerful than *TK! Solver Plus* before plunking down their money.

IAS

If, when you go to a restaurant, you enjoy the ordering more than the eating (one way to tell if you're a fan of menus), you'll like *IAS*, $249 from Analysis Technology. The most distinctive feature of Version 1.91 is an interface heavily dependent on menus and prompted dialogs.

If you want to study a damped sinusoid in another program, typically you type in

$$f(x) := \exp(-x)*\sin(x)$$

To do the same with *IAS* (short for *Interactive Analysis System*), starting at the main menu, you must choose successive submenus called Generate Function, Function Menu, and Periodic Functions until you arrive at Sine. Picking it, you find a dialog asking you to specify the number of points, amplitude, frequency, and phase of the sine and also the interval on which you want it stored. When you've answered all the questions, the appropriate sine values will be stored in *IAS*'s array 1. Returning to the main menu, you must go down another menu tree to interchange arrays 1 and 2, and then down the Generate Function Submenu tree to produce the exponential. Finally, a third menu traversal is required to multiply array 1 by array 2. Some may find this approach attractive, but others are certain to find it tedious.

There are several shortcuts available: each of the hundred menu items has its own unique two-letter code, and you can bypass menu layers by directly entering the codes you want. You can also assign up to ten frequently used two-letter codes to function keys, but be forewarned that all that appears on the function key menu thus generated are those two-letter codes. It hardly helps matters that the manual has no index, and there is no on-line help.

It is unfortunate that *IAS*'s user interface is such a burden, because there is much to like about the program. Its graphing features are very good. You can display several functions on the same plot or alternatively shrink the size of graphs and arrange several on one screen. The program gives you access to a large number of functions and distributions, including nonstandard ones such as Hermite polynomials and Fermi-Dirac distributions. While *IAS* does not have its own programming language, you can add user-written external programs to the *IAS* menu.

The hard disk needs of this program are quite awesome. It takes up more than 2.2MB, plus another 500K of memory for temporary files that it makes each time it loads. Despite its mammoth size, as in Noah's ark, many things are limited to two: you can have only two functions, two matrices, and two vectors active at any time, so you will need to do a lot of reentry or saving/recalling from disk. Because of its size, the program is slow to load. While you are using it, it often pauses, with the disk light going on.

The program's error-trapping facilities are rather poor. When it was loaded with insufficient memory, the disk light went on and stayed on until the PC was rebooted. When a filename wasn't filled in at a prompt, the software responded inelegantly with something that looked like a compiler error message on the middle of the screen. Also, *IAS* is distributed with a copy of Microsoft's mouse menu program (dated 1983) and a compiled menu definition file. Using the latest mouse driver, we were unable to load this menu and use the mouse without crashing (we tried using both the outdated MENU.COM included with IAS as well as the one that comes with the Microsoft mouse).

The program comes with three disks of GSS graphics drivers, so you can use a wide array of display and printer hardware. Unfortunately, the program's Print command is nothing more than a print screen dump, so all your graphical printouts include the on-screen menus. The program can export graphs into a standard graphical format for importing into desk-

FACT FILE

***IAS*, Version 1.91**
Analysis Technology Co.
3914 Miami Rd., # 311
Cincinnati, OH 45227
(513) 561-1100
List Price: $249
Requires: 512K RAM, hard disk with 3MB, DOS 3.0 or later. Math coprocessor optional.
In Short: *IAS* has a large number of features with an interface made awkward by lots of menus. Its graphics are especially strong. Not copy protected.

CIRCLE 618 ON READER SERVICE CARD

top publishing programs, an option that I wish more math toolboxes supplied.

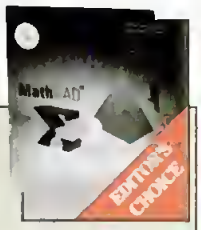
While there is a lot in *IAS* to admire, there are too many things that just don't click.

MathCAD

Billing it as a "mathematical scratchpad," *MathCAD*'s maker, MathSoft, emphasizes that the package is not for serious number-crunching since it lacks extensive language support. But if it weren't for that lack and its inability to produce three-dimensional plots, Version 2.0 would offer everything you have dreamed of in a mathematical toolbox.

Of all the math toolkit programs, $349 *MathCAD* has the most attractive and natural interface. You can invoke commands from menus, a command line, or function keys, so you'll find a comfortable mode of operation no matter what your taste. The weakest point in its interface is that the help is not context sensitive and is not available from certain menu items.

PC MAGAZINE FACT FILE



***MathCAD*, Version 2.0**
MathSoft Inc.
1 Kendall Sq.
Cambridge, MA
02139
(800) 628-4223
(617)577-1017 (in Mass.)
List Price: $349
Requires: 512K RAM, graphics monitor (compatible with CGA, EGA, VGA, Hercules, T3100, and AT&T 6300 monitors), DOS 2.0 or later. Math coprocessor optional.
In Short: *MathCAD* is a superb electronic scratchpad. It doesn't have the programmability for real number crunching, but other than that it has it all: equation solving, matrices, curve fitting, FFTs, and so on. The graphical interface makes for slow scrolling but is easy to use. Not copy protected.

Additional products: *Advanced Mathematics Application Pack*, $55; *Statistics Application Pack I*, $59; *Statistics Application Pack II*, $69; both statistics packs, $99.

CIRCLE **617** ON READER SERVICE CARD

The program runs entirely in graphics mode. It displays integrals that look like the ones you draw on paper, so you'll immediately know where to place the parameters and you won't need to consult the manual to figure out which parameters are which. It is true that the keys for most symbols are arbitrary—for example, you use "&" to get an integral—and I wish they could be redefined, but once you learn them, you're OK.

MathCAD is blessed with a plethora of functions, including some esoteric ones like spline fits. It can solve simultaneous equations and plot several functions, even parametric or log plots. And it's all easy to do. To plot one function against another, define the functions, hit "@" to get a "plot region," and fill in the names of the functions on the axes and the limits. MathSoft has recently released a toolbox of add-on worksheets that fill in some of the few gaps, like its lack of a function to find the eigenvalues of a matrix.

MathCAD's Achilles' heel is speed. On an informal performance test I did summing the first 8,000 inverse squares, *MathCAD* took almost 20 times as long as a compiled Turbo Pascal program while the speed champ, *Gauss*, took only 1½ times as long. In addition, the graphics mode makes for slow scrolling, a problem exacerbated by the program's default mode of recalculating formulas as they scroll into view. On a 386 system with fast VGA, you may not find the speed a problem, but on an XT with CGA you will. Overall, the ease of setting up a problem in *MathCAD* makes solving problems simpler than in competing programs, even on an XT with CGA. Despite this, problem solving may feel slower because in *MathCAD* you'll spend the extra time looking at a Wait message, while in another program you'll spend the extra time thinking about how to translate the program into some arcane syntax.

MathCAD has support for 25 printers and for HPGL plotters. The plots that the the program produces are informative, but they do not have the presentation quality that those of some other programs have. MathSoft offers toll-free support.

You may occasionally rant at the slow scrolling, but you'll find *MathCAD* a powerful, pleasant tool.

Point Five

Point Five, $295 from Pacific Crest Software, is what you'd expect to get if you mated APL with a spreadsheet, then examined their offspring while it was a teenager. Version 1 reminds you of a teenager because it shows occasional flashes of power while it so often remains awkward and gangly.

Since it has a multiline editor with access to what has scrolled off the screen, it resembles APL's interactive mode, but without the funny symbols. It goes one step further than the APL interface in that it segregates the output on a separate part of the screen. Its likeness to a spreadsheet is based on the fact that tables are central to what it does. By combining tables in a formula, you can do things that one might do less easily in a spreadsheet. In this respect, the program is reminiscent of *Javelin*, although not carried out as thoroughly. Unlike either APL or a spreadsheet, however, *Point Five* uses mathematical and financial formulas as its mode of manipulation.

Point Five offers an array of probabilistic and statistical functions, like Poisson distributions and chi-square functions. Its strong suit is its handling of data, and it features a large number of ways to manipulate two-dimensional arrays. While the range of functions it offers makes it suitable for certain kinds of statistical model-

PC MAGAZINE FACT FILE

***Point Five*, Version 1**
Pacific Crest
Software
887 NW Grant Ave.
Corvallis, OR 97330
(503) 754-1067
List Price: $295; *Statistical Applications*, $75.
Requires: 256K RAM, DOS 2.0 or later. Separate 8087 and non-8087 versions are included.
In Short: *Point Five* manipulates fundamental objects such as tables of data, arrays, and matrices. Interesting first version, but rather scant in functionality. Not copy protected.

CIRCLE **614** ON READER SERVICE CARD

PC MAGAZINE

"The Dataworld 286 [12MHz] AT compatible...[is]... the fastest machine of the nine tested in that review [July 1988]." (September 27, 1988).

and

... speed and excellent compatibility... hundreds of dollars less expensive than other AT compatible.

PC MAGAZINE EDITOR'S CHOICE

"Marvelously cheap, powerful alternative ... outperformed the other 286's ..."

(October 11, 1988)

NOW! 20MHz 286 Si = 22.5

DATA-286 12MHz

80286 running at 8/12Mhz, 0/1 wait state
Phoenix BIOS std. (Award BIOS opt.)
512KB of RAM, expandable to 1MB on board
Socket for 80287-8, -10
200W power supply
Real-time clock with battery backup
1.2MB floppy disk drive
Floppy/hard disk controller
(1:1 interleave controllers available)
101-key keyboard with "click"
Mono card w/parallel port (720x348)
TTL monitor with tilt/swivel base

$1195

Portacomp II

80286 running at 8/12Mhz, 0/1 wait state
Phoenix BIOS std. (Award BIOS opt.)
512KB of RAM, expandable to 1MB on board
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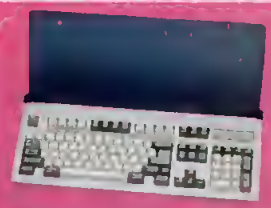

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ing, its data-handling capabilities could make it useful in the analysis of experimental or financial data.

The notion of a user-defined function simply doesn't exist in *Point Five*. Since the program uses vectors, you can describe a single function by forming the vector of its values at some regular grid of values. By replacing a function by a vector, you can formulate many problems that you'd want to solve with a math toolbox, albeit by an unorthodox viewpoint. This use of vectors will suffice for operations such as taking integrals, but because the program lacks the ability to compose functions, its usefulness for certain kinds of mathematical modeling is limited.

It will do graphs, but only in a half-hearted way: the screen resolution is CGA and it will print only a copy of the screen, although it does come with drivers for laser printers. Additionally, its command structure is rather awkward. Many commands have long names that you must type out in full to multiply matrices.

Point Five is an interesting first version that will appeal to some because of its eclectic mix of tables, mathematical functions, financial procedures, and statistical tools, but I'm going to wait for Version 2.

The Scientific Wheel
The Professional Wheel

The two words that best describe Dalin's *The Professional Wheel* and *The Scientific Wheel* programs are "simple" and "limited." Both packages, which are priced at $99 and $69 respectively ($139 for both), are highly modularized. *The Scientific Wheel*, Version 1.1, consists of a "function analysis" program, plus resident and nonresident versions of a program that includes the Unit Conversion and Calculation Processor modules. *The Professional Wheel*, Version 1.1, has four programs: an advanced, nonresident version of Unit Conversion, a statistical analysis module, and two modules that together form an advanced version of the Calculation Processor.

The different modules within each program are mostly unrelated. They do share some command keys and can be accessed from a common menu, but they do not share data, nor can you transfer information from one to another. Other inconveniences: the resident modules take up a whopping 160K, and you cannot change the hotkey assignment from Alt-=.

The Calculation Processor is a formula calculator similar to the one found in *SideKick Plus*: you can type in an expression involving the functions that the calculator understands (factorials, trigonometric and hyperbolic functions), and it will report the answer. While the functional analysis module understands integrals and derivatives, the Calculation Processor does not. It goes somewhat beyond the *SideKick Plus* calculator in allowing the definition of functions that you can refer to in calculations. It also has the added ability to calculate in feet/inches and in degrees/minutes/seconds. The advanced version of the Calculation Processor included with *The Professional Wheel* allows you to save files of calculation to disk with comments and then to print out these files.

The Unit Conversion modules are simple and elegant. Choose up to four of a given type of unit the program understands: feet, miles, meters, and nautical miles, for instance, can be chosen from the lengths unit. When you type a number in the feet column, for example, it is converted to the corresponding measurements in the other columns. The extended Unit Conversion module that comes with the program handles 14 types of units to the 6 available in *The Scientific Wheel*. The advanced version offers more choices within the 6 types of units both share: for example, 22 units of length vs. 10.

The Professional Wheel's statistical analysis module is limited to 200 data pairs that you must enter manually. While you can save data in a special *Wheels* file format, it lacks an import feature to bring data in from other programs. Despite this shortcoming, the wide variety of tools available for data analysis makes this one of the program's strongest modules. Included are frequency analysis, linear and nonlinear curve fitting, and comparisons with idealized probabilistic distributions.

My favorite module is *The Scientific Wheel*'s function analysis. You can define a function of one variable, provided the formula is no longer than 38 characters. Hitting a single key will then report all the zeros, local maxima and minima within a chosen range of variables. Other keys allow you to compute integrals and numerical derivatives.

The help is limited. It consists of little more than information about the function-key menu assignments that are already listed at the bottom of the screen. But for the most part, the program is so simple that you won't need serious help too often. That's lucky, since repeated phone calls to technical support over a 3-week period didn't get us any. Even the statistical module isn't very complex, although it offers enough features to make you read the manual.

The programs' simplicity carries through to formula entry. While most programs would force you to write 2*sin(3), the *Wheels* understand 2sin3. If your needs are few and your budget is limited, these programs are worth a further look.

PC MAGAZINE FACT FILE

Dalin Inc.
PO Box 33308
Granada Hills, CA
91344
(818) 360-7058

***The Professional Wheel*, Version 1.1**
List Price: $99
Requires: 432K RAM, DOS 2.0 or later.

***The Scientific Wheel*, Version 1.1**
List Price: $69; $139 for both.
Requires: 256K RAM, DOS 2.0 or later.
In Short: These packages are limited in scope but easy to use—a real bargain. Not copy protected.

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SolveIT

If you've grown up with Hewlett-Packard calculators and enjoy working with a mouse, you may just love *SolveIT*, Version 3.45. Featuring a user interface based on the metaphor of a programmable

PC MAGAZINE FACT FILE

***SolveIT*,**
Version 3.45
Structured Scientific Software
1509 Queen Ave. SW
Albany, OR 97321
(503) 926-8599
List Price: $129
Requires: 512K RAM, DOS 2.0 or later. Math coprocessor optional; mouse optional but highly recommended.
In Short: *SolveIT* is based on the look and feel of an HP programmable calculator with graphs, differential equation solving, and data analysis. Not copy protected.
CIRCLE 612 ON READER SERVICE CARD

reverse Polish calculator, Structured Scientific Software's $129 *SolveIT* works with a stack of 12 numbers, with the most recently used six visible on the screen.

Besides the number stack, there are two arrays of 40 functions that appear on the *SolveIT* screen. In direct mode, these functions act on the top one or two elements of the stack. You choose the one you want by using a mouse to click its name on-screen. You *can* use arrow keys and the Enter key, but a mouse is recommended.

The built-in functions include not only the standard ones but eight kinds of Bessel functions and ten functions related to probability and statistics. You can define functions and save them in files, or even place them in user-defined menus. You can import data sets of up to 256 pairs and do a statistical analysis including curve fitting.

While its programmability is not as extensive as that of the six powerhouses, this product has a more powerful programming language than any of the packages that we identify as not having extensive languages: you can pause the program for the user to enter a number, call subroutines, and branch on a number of conditions involving the top number in the stack—even on a comparison with a constant stored in one of the 2,000 memory addresses. The program computes integrals, and you can program it to compute multiple integrals over nonrectangular regions.

SolveIT does have its limitations. It has no matrix support. You can solve ordinary differential equations, but only with a single function. The program will find solutions of a single nonlinear equation involving a single variable, but only using one equation and one real variable. While it includes context-sensitive prompts, the program offers no comprehensive on-line help. It will graph a function defined by a program, but only at CGA resolution and only a single function.

The weakest aspect of the program is the tedious process you go through to define a function. You can't write something like $f(x) = x^3 + x - 1$; instead you must write a little program that first stores x in a memory, then recalls it for successive operations. You can't just type in the word *store*—you need to click on it with a mouse or hit the right function key. And it is remarkable that except when used to enter the names of files, the letter keys have no effect in this program!

This program could be a real winner if it made it easier to define functions and write programs. As it is, you'll wish your keyboard looked like that of an HP calculator.

SolveIT's user interface is based on a reverse Polish calculator.

Tekcalc

Tekcalc, $95 from BV Engineering Professional Software, consists of three components: a scientific calculator teamed with a graphing program and supplemented with a statistical analysis module. Each of Version 2.0's three components is independent, though linked through a main menu. While each is spare, they are all so easy to use that you may not need to crack the manual.

PC MAGAZINE FACT FILE

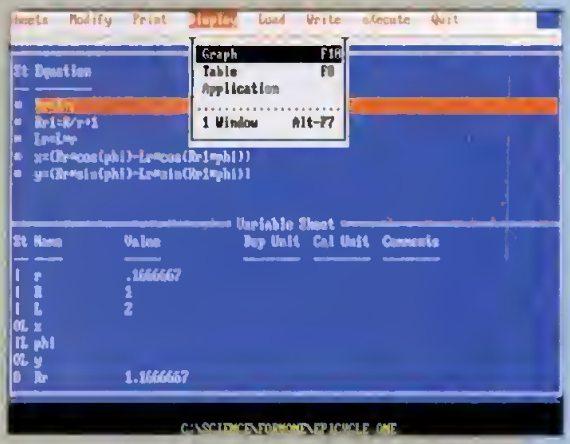
***Tekcalc*,**
Version 2.0
BV Engineering Professional Software
2023 Chicago Ave., Suite B13
Riverside, CA 92507
(714) 781-0252
List Price: $95
Requires: 256K RAM, DOS 2.0 or later. Separate 8087 and non-8087 versions are included.
In Short: *Tekcalc* includes separate calculator, graphing, and statistical modules. Its inexpensive and easy to use, but limited in functionality. Not copy protected.
CIRCLE 611 ON READER SERVICE CARD

Tekcalc's calculator is line oriented. It gives you up to 66 lines in which to type expressions of up to 54 characters. It has a number of built-in functions, though they are limited to not much more than the basic hyperbolic and trigonometric functions in real and complex versions. After you've typed in your expressions, pressing Enter displays the answer in a separate column; if necessary, you can go back and edit any line. The basic format resembles that of the Calculation Processor in the *Scientific Wheel* and *Professional Wheel* programs.

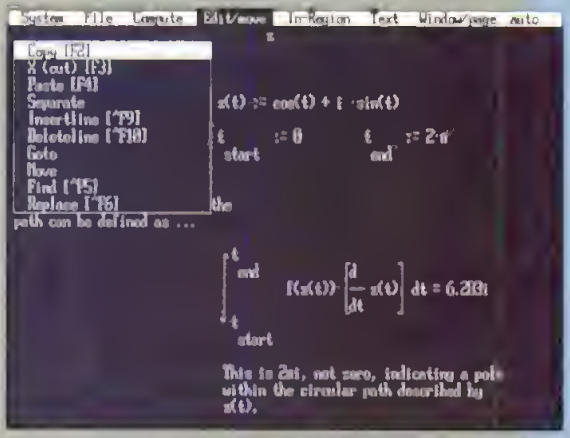
The graph module will plot a single function, either normal or parametric. The graph quality is poor, even taking into account that it is done only in CGA resolution on-screen and only on an Epson dot matrix printer.

The statistics part of the program is the most impressive. It will handle up to 512 data points that you can import from an ASCII file or spreadsheet .PRN file. It will do standard deviation, mean, linear regression, and 11 kinds of curve fits. You can graph the curve fits of the data.

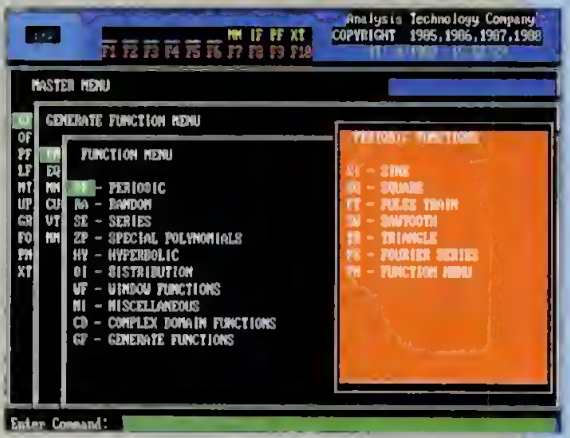
This program has considerable overlap with *Scientific Wheel* and *Professional Wheel*, which have more features and are therefore a better bargain.



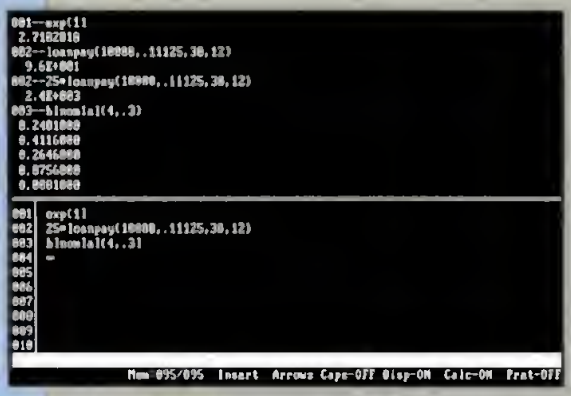
Formula/One splits the screen into separate windows.



With *MathCAD*, integrals look like integrals. The commands are invoked from pull-down menus.



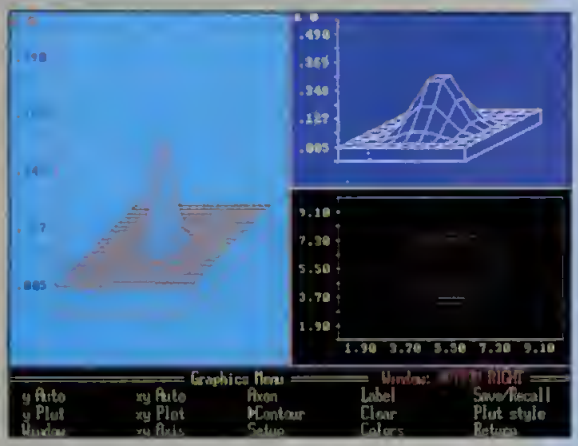
IAS uses a full-screen menu. The command line or function keys can be used to bypass the menu system.



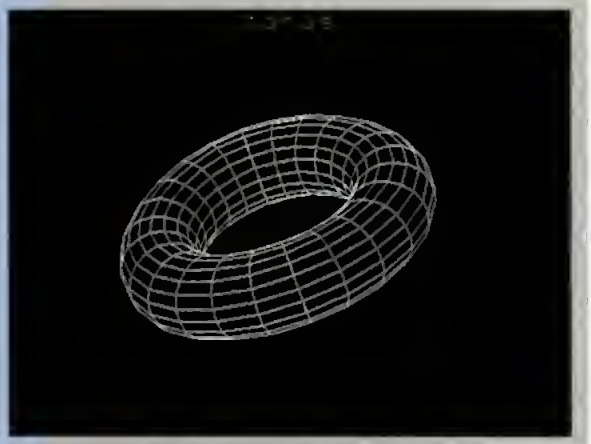
Point Five uses the lower half of the screen for command entry. It even lets you recover commands for editing and reentry. The upper part of the screen shows output.

SolveIT defines the polynomial x^3 - x^2 + X - 1.

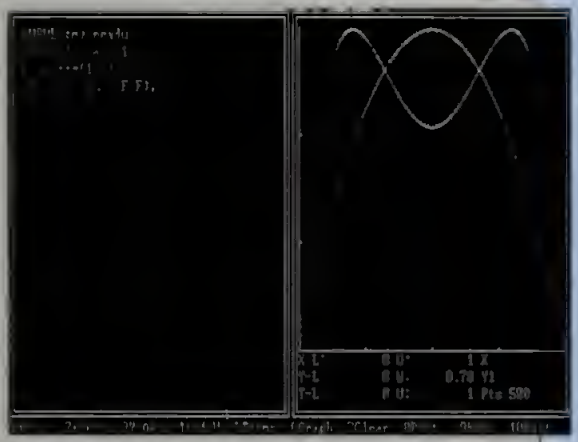
The heart of *Tekcalc* is its calculator module, with up to 66 editable lines.



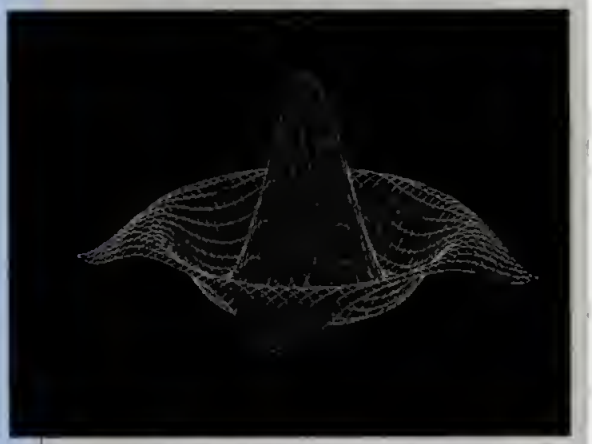
Three-dimensional and contour graphs such as these can be produced in either *Asyst* or *Asystant*.



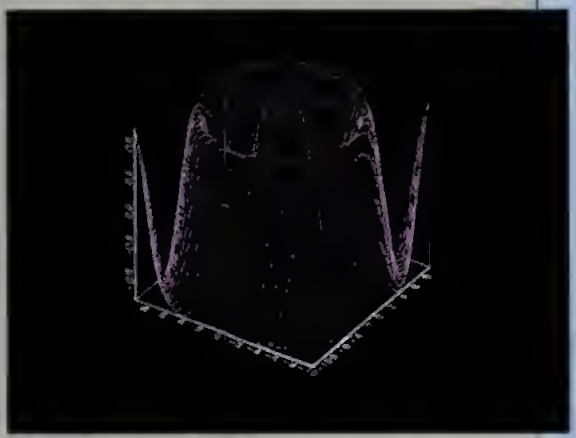
Even a simple torus looks grand with *MathGraf*.



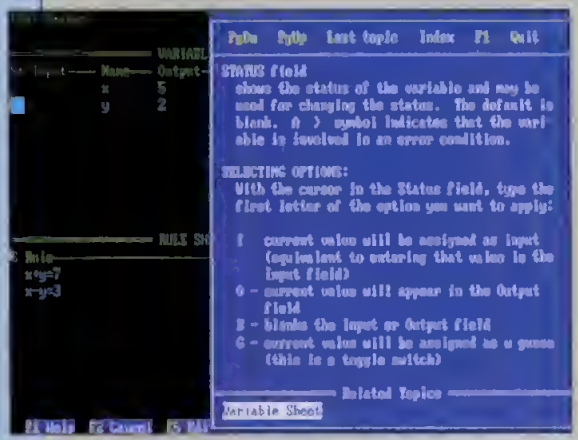
Curve graphs the functions F(*x*) and F(F(*x*)).



Matlab's graphics are outstanding. This is a graph of the function sin(*r*)/*r*.



Gauss's presentation graphics are lovely. This is a graph of the function sin(*r*).



TK! Solver Plus's context-sensitive on-line help is outstanding.

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Asyst

Like its little brother *Asystant* (also reviewed here), Asyst Software Technologies' $1,695 *Asyst* is best used as a data analysis tool. It has excellent graphics and even more links to special data acquisition hardware than does *Asystant*. An extensive programming language gives Version 2.1 a considerable amount of flexibility and ability. For instance, you can design your own screen layout for graphs by splitting the screen into windows with any locations you like.

Individual commands called *words*—which are usually descriptive, like "load.overlay"—form the basis of the language. Some words are built-in; others come in overlays that you can load into the program; you can also write programs to add your own words to the vocabulary. *Asyst* maintains three separate stacks: one of previous commands, one of strings, and one of numbers. Words typically act by pulling numbers out of the stack, operating on them, and then placing results back on the stack. For example, the word "+" takes the top two numbers of the stack and places the sum back on the stack. Since words can be strung together and numbers can be placed alone on top of the stack, the familiar reverse Polish syntax results, so that 2 3 + would place 5 on the stack.

The potential difficulty for most users is that since *Asyst* was written in Forth, its programming language also uses Forth's reverse Polish notation. Hence a loop to sum the first 8,000 inverse squares, which in Pascal would read

for $i = 1$ to 8000 do sum := sum + i^{-2};

becomes .

8001 1 do *i* -2. ** sum + sum := loop;

in the *Asyst* language. Likewise, "if a then b else c" becomes "a if b else c then". Forth you speak if, this like may you, else it a problem may be then. Personally, I think many people will have trouble learning to program in *Asyst*.

To add to the shortcomings of the language, it is not very intelligent about data types. In most modern languages, integer expressions are automatically turned into reals so that 2^{-2} becomes .25—but not in *Asyst*, which rounds all integer expressions down to 0. That's why in the above example, "8001 1 do", you'll find a period after the 2 to force *Asyst* to interpret it as a real number. I always thought that computers were supposed to handle these things for me.

Asyst Software Technologies' support policies could use some improvement as well. When you pay $1,700 for a product, you don't expect to find that you'll have to pay extra for support after the first 60 days, nor that you'll have to cope with copy protection.

FACT FILE

***Asyst*, Version 2.1**
Asyst Software Technologies
100 Corporate Woods
Rochester, NY 14623
(716) 272-0070
List Price: $1,695 for modules 1 and 2 including graphics, data analysis, RS-232; $2,295 for complete package (modules 1–4). Different module combinations available; academic and quantity discounts.
Requires: 512K RAM (640K recommended), math coprocessor, parallel port, graphics card, DOS 2.0 or later.
In Short: *Asyst* has superb graphics and fine data analysis tools including a powerful Forth-like language. Its reverse Polish notation syntax will be difficult for some. Copy protected with parallel port block.

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It's too bad that *Asyst* has these shortcomings, since there is much to like about it. Besides being able to recall previous commands, you can start a command and hit a single key to get a pop-up window of the possible ways to complete it. Just as important, the program modules fit together well, and overall, it has a lot of functionality and power. The documentation is clear, although overwhelming: including the documentation for the data hardware modules (that we did not review), it takes up more than a cubic foot of space.

If your needs are heavily oriented toward data analysis—especially if you have a supported data acquisition board and you'd like to import data from it directly into your toolbox—*Asyst* may be the best choice for you.

Curve

Curve Systems International's $99 offering in the math toolkit market should have been called *Series* rather than *Curve*. Version 1.02's approach to the representation of functions is a unique and fascinating one that should appeal to theoretical physicists and mathematicians alike. In the other packages reviewed, functions are represented in one of two ways: either by an explicit algorithm (functions defined as programs), or by the values of the function at a closely spaced set of points (functions as arrays). *Curve* instead represents a function by a power series about a point—or, more precisely, by the first 60 terms of such a series. This forces one to think of the functions themselves, rather than of their values, as the basic objects.

Operations on the level of functions become especially natural in this framework. *Curve*, out of all the programs reviewed, is the only one that will deal with functional inverses. And the composition of functions, which is awkward in a program like *Asystant*, is easy here.

Curve has to cope with the fact that power series often have limited regions of convergence, making for potential difficulties when you want to get out numbers. For example, the power series for $f(x) = 1/(1 + x^2)$ will theoretically converge only if x is smaller than 1. *Curve* takes a conservative point of view and actually warns you of possible errors if x is larger than 0.27. If *Curve* stopped there, it would be unacceptable, but it has a set of continued fraction approximation methods that allow for numerical evaluation in most cases. There aren't many rigorous mathematical theorems justifying continued fraction approximation, but it is known to work re-

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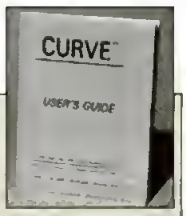

Curve, Version 1.02
Curve Systems International
747 Moreno Ave.
Los Angeles, CA
90049
(213) 551-6695
List Price: $99
Requires: 512K RAM (640K RAM with help screens), graphics card, DOS 2.0 or later. Math coprocessor optional but highly recommended.
In Short: *Curve* is a unique power series/rational approximation approach to mathematical problems. The user interface isn't all that it could be, and other computer-related aspects of the program need work as well. Not copy protected.

CIRCLE **622** ON READER SERVICE CARD

markably well.

By combining this strategy with a flexible programming language and simple but productive graphical tools, *Curve* can effectively deal with a number of problems. While many other programs force you to switch back and forth between graphics and text mode, *Curve* makes graphic tools more accessible in graphics mode by devoting half the screen to plots and half to formulas.

For what *Curve* is designed to do, it is very powerful. However, it has a very specific focus and is limited to scalars and to functions of one variable. And while its underlying philosophy is sound, the implementation of certain features leaves a lot to be desired. Help is not accessed directly, but via *SmartKey* macros that have problems working in some graphics modes. You can edit only using the Backspace key, and you cannot recall previously issued commands; your only choice is to retype them. The on-screen design is less than attractive: text display is only 40 columns wide, and output is wrapped to the next line without any attention to where words or numbers end.

Curve uses case-sensitive words in a way that drove me batty. For instance, if you defined *X* first, it would accept

F = Sin(*X*)

but would respond to

F = sin(*X*)

with "I'm sorry, but I am confused by 'X'". After a few of those messages, I didn't feel like being as polite to the program as it was to me!

While I had no problem running *Curve* on a machine with a true-blue EGA card, it refused to run in graphics mode on my Genoa EGA clone. When I asked it to find the functional inverse of $1/(1+x^2)$, admittedly an impossible task, it gave an error message but then proceeded to crash. The publisher has promised to fix these problems.

Despite these problems, *Curve* is an intriguing, aggressively priced product worthy of consideration.

Gauss

Aptech Systems' *Gauss* is a powerful matrix-based language. Version 2.0 boasts the most machine-level hooks of any of the mathematical toolboxes reviewed, offering access to items like the amount of free disk space and the current date, both of which can be useful when writing data to disk. It also has a broad array of built-in functions including matrix manipulation, sorting, and statistics. However, it handles complex matrices and numbers in an awkward way: you must distinguish between real and complex numbers and use special versions of functions on the complex quantities.

In our informal time tests, the $395 program proved itself to be the speediest at computation, often almost as fast as compiled Turbo Pascal code. You can arrange to autoload commonly used functions that you've built; once loaded, the function is compiled not into machine code but into an efficient pseudo-code. If you type in a function name that it doesn't already know, "foo" for example, it will search on-disk for a file called foo.g; if it isn't found, it will search in various function libraries. Because of the disk search, the initial call to a function can be slow, but later calls will be very fast.

Gauss has two levels of graphics: quick plots and lovely presentation-quality mode. In the latter mode, it supports only half-page graphics on HP-compatible lasers, even if you have sufficient memory for a whole page of graphics. Unfortunately, the program only supports VGA at EGA resolution.

You can invoke your own editor from inside *Gauss* or use the built-in programmer's editor that is patterned after the well-known *Brief* programmer's editor, although it lacks the latter's macros or undo feature. You also have a full-screen editor for issuing commands, but it is limited to displaying the current screen of commands and one previous screen. Particularly when the output of some functions causes commands to roll off the screen, you'll wish more commands were retrievable. While you can cut a block of commands to a buffer for later recall and edit, you'll wish there were more than one buffer available. Luckily, it is easy to reissue commands.

The matrix editor could be better designed: it does not give you a spreadsheet view of the matrix but only the matrix forced into a vertical array.

If you have an 80286 or 80386 machine, for a $3 fee Aptech will supply a version that makes special use of the processor. Unlike *Matlab* and *APL*Plus II*, the 80386 version does not yet exploit the

FACT FILE

Gauss, Version 2.0
Aptech Systems Inc.
26250 196th Pl. SE
Kent, WA 98042
(206) 631-6679
List Price: $395
Requires: 640K RAM, math coprocessor, DOS 3.0 or later.
In Short: The speediest and most versatile of the mathematical programming languages, *Gauss* has a steep learning curve. Not copy protected.

Additional products: 286/287 and 386/387 versions available for a handling fee of $3 each; graphics conversion package (to GEM and .PIC format), $30; *Gauss* Beautifier (pretty code printer), $50; *Gaussx* (econometrics shell for *Gauss*), $100.

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large memory space or large arrays possible on such a machine, although such a version is promised. I'm looking forward to seeing it because *Gauss* often bumps its head on the 640K barrier. When the program was loaded with 420K free, I was unable to do an operation on an 8,000-component vector. Even with 500K free, I was unable to work with any three-dimensional surfaces. You'll find that you'll probably have to dump most of your resident programs when you run *Gauss* to give it the maximum elbowroom.

It may seem strange to fault a 700-page manual for being too brief, but it is. The reference part of the manual is clear, but the alphabetically ordered command reference should be supplemented with a grouping by functionality; the introductory material is confusing, and the 11-page tutorial is totally inadequate. The manual desperately needs to show worked-out examples of some of the program's advanced features.

It's a shame that the manual isn't better designed, since *Gauss* is not an easy program to get into in the first place. But if you're willing to make the effort, you'll find it to be a powerful, flexible, and speedy tool.

MathGraf

Caren Co.'s $695 *MathGraf*, as its name implies, is designed to graph mathematically defined objects. Fittingly, the software's real strength lies in its graphics; Hercules, CGA, and EGA displays are supported, and you can choose from among 30 different fonts to label your graphs. I run out of superlatives describing the display: simply put, *MathGraf* has the best two- and three-dimensional screen output that I've seen in a mathematically oriented program, although you'll really need a PostScript printer to achieve the same dazzling effect on paper.

The basic objects that you'll work with are one- and two-dimensional arrays. After any set of commands is executed, the Y array is displayed against its index variable (or variables, in the case of two-dimensional arrays). Operations are also done on the Y array: for example, the command +A would add the A array to the Y array and store the sum in Y. The set of mathematical functions that you can apply to Y is extensive: not only the standard ones but even hypergeometric functions are available.

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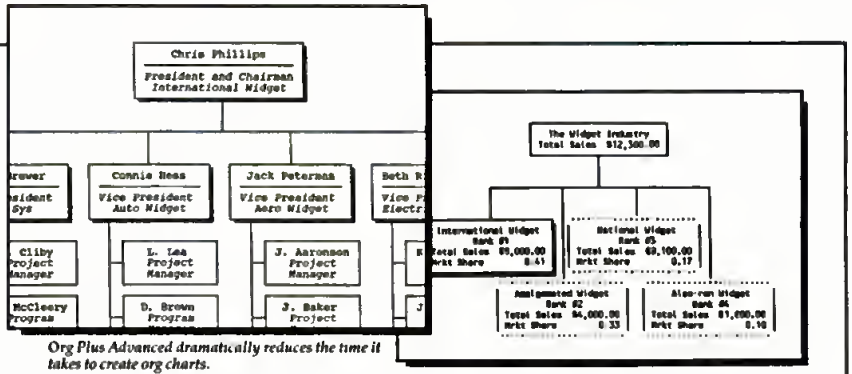

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PC MAGAZINE EDITOR'S CHOICE

- Gauss
- MathCAD

Among the products without extensive programming languages, it isn't close: MathCAD *by a mile. It has the widest array of functions and an interface that is closest to a pencil and paper. Its weakness is in speed, but for applications where the major time factor is the formulation of the problem, MathCAD's easy interface makes up for its slowness in scrolling and calculation.*

Among the high-end products with extensive programming languages, the choice is more difficult. Asyst *is well suited for those with data acquisition hardware if you can cope with the price, the copy protection, and the reverse Polish language. If your main need is graphical output,* MathGraf *is outstanding. If you need* Matlab*'s signal analysis or* TK! Solver Plus*'s gear analysis models or links to* AutoCAD*, these packages will add to your productivity. But for most users the product of choice is Aptech Systems'* Gauss.

For number crunching, speed is a most important factor, and Gauss' *speed is impressive. Its programming language has the most low-level hooks to the PC, and its set of routines can't be beat. It offers both quick graphics and magnificent presentation-quality graphics. While we wish it had a decent matrix editor and an option to save more than two screens, its user interface is as easy to deal with as any other complex piece of software. And its competitive price is icing on the cake.*

Wolfram Research's Mathematica *was only in beta testing when this article was written. While* Mathematica *doesn't have the ease of use of* MathCAD *or the speed of* Gauss*, the beta version we looked at suggests that it will set a new standard for the level of mathematical problems that can be studied on the PC. Once* Mathematica *is released, we expect it to be a strong contender in any evaluation of mathematical toolboxes.*

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MathGraf
Caren Co.
12137 Midway Dr.
Tracy, CA 95376
(209) 835-0295
List Price: $695; network license, $1,390
Requires: 640K RAM, DOS 2.0 or later, math coprocessor (noncoprocessor version available).
In Short: *MathGraf* has a powerful language for displaying gorgeous two- and three-dimensional graphs on-screen or to PostScript devices. Copy protected with parallel port block.

Additional products: *MGWriter* to combine *MathGraf* output with text, $250; network license, $500.

CIRCLE 616 ON READER SERVICE CARD

ing with Y, although it can be awkward. Because all operations are done on the Y array, the interactive mode has the feel of a reverse Polish calculator to those relatively inexperienced with RPN; true fans will realize that without a stack and with mixed Infix and Postfix notation, *MathGraf* can't really qualify as one.

Since you can issue a command to print an array or an array element on the screen, you could use this program for numerical analysis, but that would be awkward.

In *MathGraf* you write programs that the company calls macros. There are only two language constructs: various "if" statements that can branch to one of two macros in an if-then-else format, and the repeated calling of a macro. The language is terse—so much so that it makes APL seem verbose. The macro to display a torus on your screen is only three lines long, yet is jam-packed with roughly 30 separate commands. The manual could use some clearer introductory material and examples explaining the programming feature in more detail. On-line help would come in handy here as well.

MathGraf is a memory hog. It was the only program that would not run in a machine with over 500K free and that required me to boot with no resident programs loaded.

Other implementation flaws make working with the program something of a hassle. While you can write and save macros, you cannot save sets of commands issued in interactive mode. This means you'll need paper and pencil close by when developing programs in order to keep track of the interactive commands you're trying out. Command editing in interactive mode is limited to the usual DOS editing keys: F3, for example, recalls the last command. One of the most annoying aspects of the program is its copy protection.

MathGraf will be a difficult program to master, but if superb graphical output is your goal, it is worth the effort.

Matlab

The "Mat" in *Matlab* is short for matrix, not mathematics. While the Mathworks' $695 toolbox package offers several nonlinear functions, its focus is on matrices. Version 3.1's basic numerical object is a matrix; the program even treats a scalar as a 1-by-1 matrix. If linear analysis is fundamental to your work, this program is the one to choose, but its support for topics like integration and equation solving is weak.

As you would expect, *Matlab*'s matrix support is outstanding. Large amounts of data fit naturally into two-dimensional arrays (as the popularity of spreadsheets attests) and Matlab supports what it calls *column-wise data analysis*, which includes correlations and curve fitting. The program contains rather specialized tools like

the Schur decomposition and functions for dealing with signal analysis. Complex numbers are treated in a transparent fashion by the *Matlab* program so that, as long as you include a command like "i = sqrt(-1)" in your startup file, *Matlab* understands what sin(i) is.

The program's interface is rather stark: no menus and no function keys. Instead, you face a ">>" prompt from which you must issue commands. There *is* a stack of previously used commands accessible with the Up arrow, and you can edit those commands. Help is available by typing in "help" alone or followed by a specific topic.

Much of *Matlab*'s work is done with external program files. Almost 200 come with the package, and you can make your own. When you type in a function name or command that the program doesn't recognize, it looks for a program file. If one is found, it is loaded and compiled in memory. Henceforth in that session the file will be instantly available.

Matlab does not come with a built-in editor to make custom program files, but expects you to use your own. As long as you have an editor, the structured language is rather easy to use. (If you have sufficient memory, you can invoke your editor directly from the *Matlab* prompt since you can run any DOS command by prefacing it with the "!" character.)

Originally written for minicomputers, the programming language doesn't include gotos or case statements, but does offer if-then-else, for, and while loops. You can exit a loop or an entire subroutine as part of a conditional statement. Because of the program's minicomputer origins there are many other platforms with compatible *m*-files, so you could debug an *m*-file on your PC and then do real number-crunching on a VAX or Sun.

The program includes external files for solving systems of differential equations, though many of these are documented only in a read.me file—the same one that was there 18 months ago. Since the manual is looseleaf, it's difficult to understand why complete documentation for this module hasn't been added.

Matlab will not solve nonlinear equations, although you could use its minimization module, also in the read.me file, to make your own equation solver. This solution (by minimizing the sum of the squares of the differences of the two sides of your equations) is not an efficient way to solve equations, and informal tests showed that it was quite slow compared with programs having built-in equation solvers. It also does not have built-in support for integration, and its derivative function is rather limited. It would be rather easy to make your own Simpson's rule integration function, and you could also improve the handling of differentiation.

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***Matlab*, Version 3.1**
The Mathworks Inc.
21 Eliot St.
South Natick, MA
01760
(508) 653-1415
List Price: *Matlab*, $695 with *Signal Processing Toolbox* included; *386-Matlab*, $1,495 (requires 80386 computer, 1MB of extended memory); Weitek version, $1,995 (requires 80386 computer, 1MB of extended memory, and a Weitek math coprocessor chip).
Requires: 320K RAM, math coprocessor, DOS 2.0 or later.
In Short: *Matlab* offers a full-featured programming language for manipulating matrices with excellent graphical support. Not copy protected.

Additional products, *Control System Toolbox*, $495; *System Identification Toolbox*, $495; *Chemometrics Toolbox*, $295; *MMLE3 State-Space Identification Tool*, $295; *Robust-Control Toolbox*, $495 (note: the last two require the *Control System Toolbox*).

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Matlab's graphics are superb. The program has not only the standard two-dimensional plots, but three-dimensional plots as well. Its output on a laser printer is magnificent. It has built-in support for many different monitors and printers; for those it doesn't support, it will link to GSS drivers, which The Mathworks will sell to users at extra cost.

Matlab is an excellent package, especially if your stock-in-trade is matrices.

TK! Solver Plus

There is much to admire in Universal Technical Systems' $395 *TK! Solver Plus*, yet it's a difficult program to develop a liking for. While its solver is neat and simple and you can accomplish a lot using its other features, these last are not easy to access. Its programming language, though powerful, seems to be intended mainly for the modules supplied with the program; the manual yields few clues on how users can develop their own routines.

Version 1.0's basic solver engine depends on an elegant division between equation and variable sheets. While it should be emphasized that *TK! Solver Plus* was on the market before *Formula/One* (reviewed here), the two programs have an almost identical solver; the feature is fully explained in the earlier *Formula/One* review. There are some differences in the parametric function plots, but again, the two programs are sufficiently close in this area that the description of the function in the *Formula/One* review also describes the complexity of performing even such a simple task in *TK! Solver Plus*.

TK! Solver Plus carries the concept of separate sheets, which works so well in the solver, to an extreme, making it somewhat cumbersome to move among features. Besides the equation and variable sheets, there is a sheet to keep track of lists (variables that run through a sequence of values, such as you might want in a sum). There is a sheet to handle unit conversions, allowing you to easily switch from inches to centimeters. The function sheet is designated for writing programs, and there are other sheets for creating plots and tables and for specifying preferences. The program is made easier to use by excellent on-line help.

TK! Solver Plus will let you deal with complex numbers and matrices, but not in a transparent way. You must indicate a complex number by a pair (x,y), with special notation for functions. For instance, while x^3 is the cube of a real number, *TK! Solver Plus* doesn't understand $(x,y)^3$. Instead, you'll need to use POWER((x,y),3). A matrix in *TK! Solver Plus* is not an intrinsic object but rather a list of lists. If you use only the canned matrix functions that *TK! Solver Plus* comes with, this won't matter too much. However, if you write your own programs to deal with matrices, you'll find overhead associated with this way of handling them.

One of the program's strengths is its wide array of external functions included on-disk as well as in separate, add-in packages. The basic program comes with 12 directories' worth of on-disk files: about 150 in all, including matrices, finance, optimization, statistics, and differential equation modules. The additional-cost items cover

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***TK! Solver Plus*, Version 1.0**
Universal Technical Systems
1220 Rock St.
Rockford, IL 61101
(800) 435-7887
(815) 963-2220 (in Ill.)
List Price: $395
Requires: 384K RAM, DOS 2.0 or later.
In Short: *TK! Solver Plus* is a powerful package with a solver core that's easy to use, although advanced features are not so easy to use. *TK! Solver Plus* offers many on-disk models. Not copy protected.

Additional Products: The equation solver alone is available as *MiniTK*, $20; *Roark and Young's Formulas for Stress and Strain*, $595; *Heat Transfer Calculations using TK*, $495; *TK!/AutoCAD* link, $195; over 60 gear-analysis models with pricing from $25 to $800; *SolverPacks for Mechanical Engineering*, $70; *Financial Management*, $70; *Introductory Science*, $70; *Building Design and Construction*, $70; *Unit Conversion*, $50; *SolverPacks* to accompany two engineering textbooks: *Hick's Handbook of Engineering Calculations*, $50, and *Fink and Beatty's Handbook of Electrical Engineering Calculations*, $60.

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everything from specialized programs to design gears to a $595 engineering textbook entirely in *TK! Solver Plus* format. Especially noteworthy is a link program that lets you use *TK! Solver Plus* to do calculations needed in *AutoCAD*.

The makers of *TK! Solver Plus* offer a $20 program called *MiniTK*, which can be freely copied and given away. It includes the full equation solver (limited to 24 equations and no more than 32 variables that cannot be lists but can be complex numbers) and unit conversion modules, as well as the relevant on-line help. It's a real bargain.

TK! Solver Plus is an interesting program, especially if your models are heavily dependent on solving equations or if you need the link to *AutoCAD*.

Barry Simon is a professor of mathematics and theoretical physics at Caltech and vice president of the American Mathematical Society.

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Tear out and hole-punch the command summary on this page and add it to your DOS manual.

LITES.COM Command

Jeff Prosise 1989 No. 5 (Utilities)

Purpose: Replaces an RS-232 breakout box by displaying the status of the DTR, DSR, RTS, CTS, DCD, and RI pins; also indicates the data rate, parity, number of data bits, and number of stop bits of the serial port being monitored.

Format: `LITES [comport] [U]`

Remarks: LITES is a memory-resident utility and may be loaded either at the DOS prompt or as part of an AUTOEXEC.BAT file. If no communications port is specified, the default *comport* monitored is COM1. After loading, pressing Alt-L (the default hotkey) alternately pops up and cancels the on-screen display, which is located (by default) in the upper-right-hand corner of the screen. LITES can be deinstalled by entering it with the optional u (or U) parameter, which simplifies changing the *comport* to be monitored. (Do not precede the U with a slash.)

The various default options of LITES can be changed with DEBUG.COM. The procedure is explained in the printed article, which also contains full tables of scan codes, shift masks, colors, and the like. The available patch points, bytes allocated, and default values are listed below.

Function	Address	Bytes	Default
Hotkey ID String	0155h	8	Alt-L
Hotkey Scan Code	0160h	1	26h
LITES Video Attribute	0161h	1	70h
LITES Display Row Number	0162h	1	0
LITES Display Column Offset	0163h	1	0
Refresh Frequency Counter	0164h	1	2
Default COM Port Designator	0165h	1	0
Hotkey Shift Mask	01A0h	1	8

Available for downloading from PC MagNet (see the sidebar "LITES by Modem"), LITES.COM is already compiled and ready to run. LITES.BAS will automatically create LITES.COM when run once in BASIC. To create LITES.COM from the LITES.ASM source code requires use of a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM LITES;
LINK LITES;
EXE2BIN LITES LITES.COM;
```

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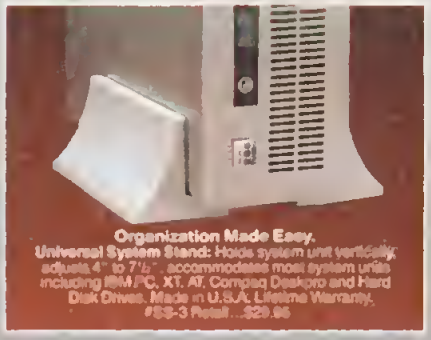

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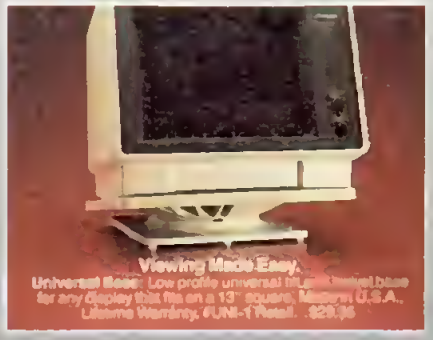

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■ UTILITIES ■ JEFF PROSISE

YOUR FREE SOFTWARE BREAKOUT BOX

Costly hardware breakout boxes can tell you why your serial printer won't print or your modem won't send. LITES.COM gives you the same information without touching a cable.

The dancing lights on your modem provide welcome reassurance that bits of data are flowing to or from your PC. But all too often when you connect a peripheral—a modem, a printer, or a laptop computer—to one of your serial (COM) ports, it just sits there, silently mocking all the trouble you have already taken to get the correct 9- or 25-pin cable and adapter.

Fixing the problem when two RS-232-compatible devices (discussed in the sidebar "RS-232 Standard Communications") won't talk to each other is usually as easy as finding which DIP switches to flip or which program options to select. But knowing where to look isn't at all easy when there is "nothing" going on.

To diagnose what *is* happening when nothing seems to be, technicians use a device known as a breakout box. In a breakout box, an array of LEDs is connected to all the important wires in the cable, so the status of any pin can be determined at a glance. If the Clear to Send line or any other pin should be set high and isn't, that fact becomes obvious when its LED fails to light up.

A breakout box is a costly solution to what is probably an infrequent problem, however. And fortunately, with very few limitations, it can be simulated through software. The LITES utility presented here does this and more. LITES is a memory-resident program that monitors the status of critical RS-232 pins while other programs run in the foreground. In addition, it tells you the communications parameters—data rate, parity, number of data bits, and number of stop bits—for which your serial port is initialized and which of its four input control pins and two output control pins are asserted (set high) at any given time. With LITES, therefore, you will be able to diagnose those sticky asynchronous I/O problems without having to resort to buying expensive hardware or exploring trial-and-error solutions.

LITES.COM can be downloaded from PC MagNet, as explained in the accompanying sidebar "LITES by Modem." The assembly language source code, LITES.ASM, is printed here, as is LITES.BAS, a BASIC program that will automatically create LITES.COM when you run it once in BASIC. Both LITES.ASM and LITES.BAS can also be downloaded from PC MagNet.

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Routines for sorting, updating, and merging sequential files.
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Adding a hard disk to a Compaq; DEBUG's N and W commands.
CONNECTIVITY CLINIC
WordPerfect on a LAN can be easier; a tip about the future of LANs.

USING LITES The syntax for LITES is simply

```
LITES [comport] [U]
```

where *comport* is the number of the COM port to be monitored (1 for COM1, 2 for COM2, and so on). If you don't designate a *comport*, LITES defaults to COM1. Running LITES with an uppercase or lowercase U following the program name will uninstall a previously loaded copy of the program. You'll need to do this when you want to switch from monitoring one COM port to monitoring another. [*Note: do not use* /U, *which will simply bring up the "usage" error message. LITES does not use the "slash" delimiter—Ed.*] If a subsequently loaded TSR has stolen away one or more of the interrupts LITES uses, thereby precluding a safe deinstallation, LITES will give you a "Cannot uninstall" message.

Once the utility is loaded, Alt-L brings up the LITES display, and pressing Alt-L a second time removes it. By default, the LITES status line appears in the upper-right-hand corner of your screen. Figure 1

shows how the indicators are organized. The panel in the rightmost corner indicates the parameters in effect at the serial port. (The data rate is measured in bits per second, or bps—and is often incorrectly called the baud rate.) If the port is set to 1,200 bps with no parity, 8 data bits, and 1 stop bit, LITES will display 1200 N81. If the rate indicator reads zero, then the UART (the Universal Asynchronous Receiver/Transmitter chip at the heart of the serial port) hasn't been initialized. Some BIOSs initialize the UART to a default setting when you boot up, while others do not. Each of the screen readouts is constantly updated so that a change in data rate or data format will be reflected instantly in the on-screen display.

In addition to monitoring the UART itself, LITES also monitors the RS-232 pins DTR, DSR, RTS, CTS, DCD, and RI. These are diagramed in Figure 2 and more fully explained in the "RS-232 Standard Communications" sidebar. LITES indicates that a pin is asserted (turned "On"—that is, set to logic 1 voltage) by displaying its name on the status line.

RS-232 STANDARD COMMUNICATIONS

The rapid transfer of bits between your computer and your modem is made possible in the first instance by a tiny chip in your serial port called a UART, or Universal Asynchronous Receiver/Transmitter. Within the computer, all the bits in a byte of data travel down the bus simultaneously, in parallel. The UART decodes data pulled off the computer's internal bus, frames it into a packet with a designated number of data bits and stop bits and the proper parity bit, and transmits these bits sequentially (that is, in serial fashion) at a precise rate. For incoming data, the UART does the exact opposite; that is, it transforms raw bit streams into easily decipherable byte-sized chunks.

The UART, though an indispensable part of serial communications, does not dictate just *how* two pieces of equipment are to be connected. This is the task of the RS-232 standard. Revision C of the Recommended Standard 232 (known simply as RS-232C) is a widely circulated but unfortunately incomplete electrical specification published by the Electronics Industries Association. The standard defines the 25 interchange circuits used to transfer serial binary data between a terminal and a modem in synchronous or asynchronous fashion. These 25 circuits correspond to the 25 pins found on a DB-25 serial port connector. Of the 25, only a handful are needed for asynchronous I/O, however. Thus, the serial ports found on many microcomputers, including those on the IBM PC AT, contain only the 9 pins commonly used in asynchronous data exchange.

Two pins—TD and RD, for Transmitted Data and Received Data—are used to transmit and receive data. A byte sent from the computer's serial port travels over TD one bit at a time (hence "serial communications") to the modem. Bits returned by the modem are sent over RD. A third pin is used as a signal ground.

Other pins, such as RTS and CTS (for Request to Send and Clear to Send), are used exclusively for line control. In half-duplex handshaking, a computer will assert RTS before transmitting a bit over TD to tell the modem on the receiving end that it is ready to transmit. The computer then waits for the modem to respond by asserting CTS. The modem is programmed to assert CTS when it senses that the RTS line has gone high, as long as no internal action is pending or in progress that would prevent it from properly receiving the data. Then it enters a loop waiting for the data to arrive.

That seems simple enough. But one of the problems with RS-232 is that although pin assignments are well defined and their intended functions clearly documented, people can still implement the hardware and software in slightly different ways. For example, while the RTS and CTS lines can control the *flow* of data bits between two devices, the RS-232C standard provides an additional pair of control lines that are sometimes used and sometimes not. The DTR (Data Terminal Ready) and DSR (Data Set Ready) pins are sometimes used at the computer and modem ends, respectively, to provide what is essentially an "I'm here" signal independent of RTS and CTS. If a program for driving a serial printer expects the printer to assert Data Set Ready when it's ready for another byte of data, but the printer asserts CTS instead, the printer will appear dead when in reality it's just not getting data from the computer. That's the kind of thing that LITES is particularly useful in catching.

Furthermore, RS-232 stops short of defining standards for interchange between two pieces of equipment that both qualify as "terminals" or, in the language of RS-232, Data Terminal Equipment (DTE). RS-232 expects to find a DTE (a computer) on one end and a modem, or Data Communication Equipment (DCE) unit, on the other. Real-world interfacing frequently involves linking DTEs in nonstandard RS-232 configurations. This is the result, for example, of connecting a laptop to a desktop computer for direct data transfer via a null-modem cable. The null-modem cable crosses some pins and shorts others together in such a way that a DTE *looks* like a DCE device. Unfortunately, however, this is a variation on RS-232 not described by the specification. Nor does RS-232 address the wiring of serial printer cables.

LITES is a troubleshooting tool that places a glass window over the unseen world of the RS-232 port and the UART chip that drives it. For additional background on the subject of the RS-232 standard, see the PC Lab Notes column that appeared in *PC Magazine*, January 17, 1989, entitled "The Asynchronous Adapter and RS-232." For further reading, refer to Richard Hale Shaw's "The PC User's Guide to Modems," *PC Magazine*, November 29, 1988. Reading both of these articles will help you gain a better understanding of LITES.

—Jeff Prosise

If you install LITES from the DOS command line and immediately press Alt-L to pop up the status line, you probably won't see any pins asserted unless you've got a powered-up modem attached to the COM port that LITES is monitoring. Most Hayes Smartmodems and Hayes-compatible modems permanently assert CTS in full-duplex mode and may keep other pins asserted as well, depending upon exactly how the modem's configuration switches are set.

To watch LITES in action, turn your modem off and toggle the LITES display on. Then flip the modem's power switch on. With most modems you'll see CTS, DSR, DCD, and RI twinkle to life as the modem conducts a short power-on test, after which RI will turn off. If you're using a Hayes Smartmodem 1200 with the configuration switches in the default factory settings, CTS, DSR, and DCD will remain asserted. If switch 6 is set to its up position, DCD and DSR will disappear after a few seconds.

Now use the DOS MODE command to change the data rate of the serial port and watch the LITES status line change in response. For example, if LITES is monitoring COM1, enter

```
MODE COM1:9600,E,7,2
```

The LITES display will switch to 9600 E72. If you now enter

```
MODE COM1:1200,N,8,1
```

LITES will show 1200 N81.

The only limitation of a utility like LITES is that its sampling rate is limited by the relatively low frequency of the PC's timer tick interrupt. In a complex RS-232 exchange, pin voltages may change several hundred times per second. LITES samples the pins several times per second and updates the display each sample period, but it can't hope to trap high-speed voltage fluctuations. LITES therefore doesn't attempt to monitor the TD (Transmitted Data) and RD (Received Data) lines, which show the actual data flow. It takes a hardware-implemented breakout box to do that, or if you're using a Smartmodem, you can watch the SD and RD lights.

In most serial communications sessions, however, the control pins DTR, DSR, RTS, CTS, and DCD remain low or high for extended periods, giving LITES plenty of time to display an accurate indication of what's going on at the RS-232 interface level.

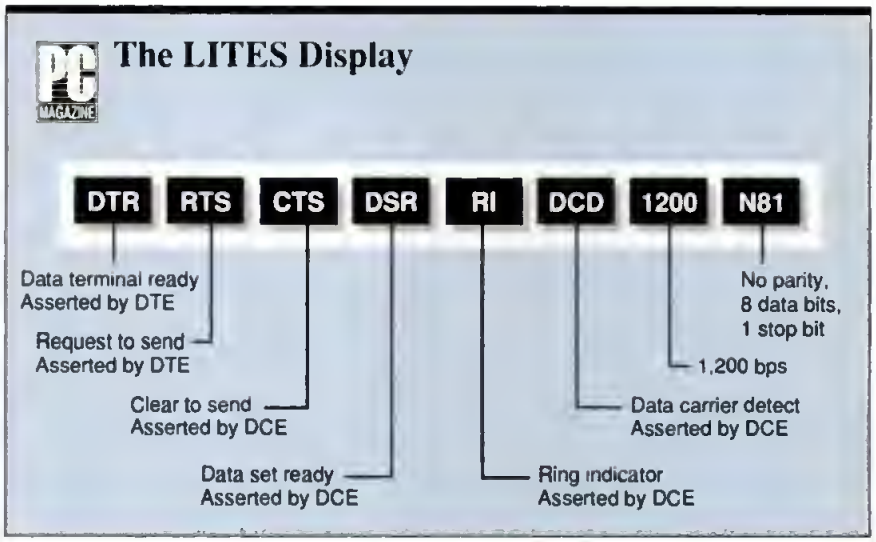

Figure 1: *LITES periodically checks the UART's data rate, data format settings, and the state of DTR, RTS, DSR, CTS, DCD, and RI, and displays them in the upper-right-hand corner of your screen. RTS (Request to Send) and DTR (Data Terminal Ready) are typically asserted when the computer is on-line and ready to transmit data. The modem normally asserts CTS (Clear to Send) and DSR (Data Set Ready) in response. DCD (Data Carrier Detect) indicates that a modem has established a carrier link with another modem, and RI (Ring Indicator) indicates that an incoming call has been detected. In most Hayes Smartmodems and compatibles, the CTS pin is permanently asserted in full-duplex mode, the DCD pin is permanently asserted unless a factory-set DIP switch is reset, and the DSR pin follows the DCD pin.*

UNDER THE HOOD LITES LITES is a relatively simple TSR that patches itself into two interrupt chains—8 and 9—to enable background operation. Intercepting interrupt 9 lets it monitor the keyboard and watch for you to press Alt-L to pop it up or down. If the LITES display is activated, at each occurrence of interrupt 8 (the PC's hardware-generated timer tick, which is called about 18.2 times per second), LITES grabs control of the machine, checks the status of the UART, and updates the on-screen status line.

To determine the UART's data format setting, data rate, and the state of its control pins, LITES reads a series of values directly from the UART itself. The UART contains 11 8-bit internal registers, 10 of which can be accessed through ports mapped into the PC's I/O address space. The diagram in Figure 2 illustrates the register mapping and the meanings of the bits in registers pertinent to LITES. LITES obtains the UART's base I/O address from a table in the BIOS data area that begins at hex address 0040:0000. The first word contains the location of the UART associated with COM1, the second word the location of the COM2 UART, and so on up to the number of serial ports installed in the machine.

The data rate, in bits per second, is determined by dividing the UART's 1.8432-MHz input clock frequency by a 16-bit value read from the LSB (Least Significant Byte) and MSB (Most Significant Byte) Divisor Latch registers, then dividing the result by 16. Setting the UART's bit rate for data transmission or receiving is a matter of doing just the opposite—*writing* an integer divisor to the Divisor Latch registers. That's what the BIOS does when called on to initialize the UART to a desired data rate through interrupt 14h.

Data format information is obtained from the lower six bits of the Line Control register. The parity designator appears in bits 3–5, a code for the number of stop bits in bit 2, and a code for the number of data

■ UTILITIES

```
;=============================================================================
; LITES displays the realtime status of the UART's DTR, RTS, CTS, DSR, DCD,
; and RI lines as well as its baud rate and data format settings.  Syntax is:
;       LITES [comport[ /U]
; where comport is a number indicating which COM port is to be monitored,
; and U uninstalls the program from memory.
;=============================================================================
CODE            SEGMENT PARA PUBLIC 'CODE'
                ASSUME  CS:CODE
                ORG     100H
BEGIN:          JMP     INITIALIZE

PROGRAM         DB      "LITES 1.0 (c) 1989 Biff Communications Co.",13,10
AUTHOR          DB      "PC Magazine ",254," Jeff Prosise",13,10
HOTKEY          DB      "Hotkey is Alt-L",32,32,32,32,13,10,"$"

;-----------------------------------------------------------------------------
; Patch points to modify the program's operation.
;-----------------------------------------------------------------------------
KEYCODE         DB      26H                     ;scan code for "L" key
VIDEO_ATTR      DB      70H                     ;status line video attribute
ROWNUM          DB      0                       ;row number of status line
COL_OFFSET      DB      0                       ;offset from right margin
TICKS           DB      2                       ;ticks between refreshes
COMPORT         DW      0                       ;COM port designator (COM1)

;-----------------------------------------------------------------------------
; Other program variables.
;-----------------------------------------------------------------------------
INT09X          DD      ?                       ;interrupt 9h vector
INT08H          DD      ?                       ;interrupt 8h vector
COUNTER         DB      0FFH                    ;refresh counter

PINS            DB      ?                       ;bit 0 = DTR, 1 = RTS
                                                ;    2 = CTS, 3 = DSR
                                                ;    4 = RI, 5 = DCD

BAUDRATE        DW      ?                       ;baud rate
PARITY          DB      ?                       ;parity setting
DATASIZE        DB      ?                       ;number of data bits
STOPSIZE        DB      ?                       ;number of stop bits

VIDEOSEG        DW      ?                       ;video segment address
VIDEOADDR       DW      ?                       ;video offset address
SYNCFLAG        DB      ?                       ;0 = no video sync, 1 = sync

PINTEXT         DB      "DTRRTSCTSDSRRI",32,"DCD"

;=============================================================================
; KBINT intercepts and handles the keyboard interrupt 9h.
;=============================================================================
KBINT           PROC    FAR

                PUSHF                           ;save flags
                PUSH    AX                      ;save AX

                STI                             ;interrupts on
                IN      AL,60H                  ;get scan code from keyboard
                CMP     AL,CS:[KEYCODE]         ;omit to BIOS if it's not
                JNE     NOT_HOT                 ;  the hotkey
                MOV     AH,2                    ;get keyboard shift state
                INT     16H
                AND     AL,0FH                  ;mask off the upper 4 bits
                CMP     AL,8                    ;exit if Alt isn't held down
                JNE     NOT_HOT
                MOV     AX,0F00H                ;get current video mode
                INT     10H
                CMP     AL,7                    ;abort if not in text mode
                JE      RESET
                CMP     AL,4
                JB      RESET
NOT_HOT:        POP     AX                      ;omit to BIOS int 9 handler
                POPF
                JMP     CS:INT09H

;
;Reset the keyboard controller and interrupt controller.
;
RESET:          CLI                             ;interrupts off
                IN      AL,61H                  ;reset the keyboard controller
                MOV     AH,AL
                OR      AL,80H
                OUT     61H,AL
                XCHG    AH,AL
                MOV     AL,20H                  ;signal EOI to interrupt
                OUT     20H,AL                  ;  controller
                STI                             ;interrupts back on
                PUSH    BX                      ;save registers
                PUSH    CX
                PUSH    DX
                PUSH    SI
                PUSH    DI
                PUSH    DS
                PUSH    ES
                PUSH    BP
;
;Deactivate the status line if it is currently displayed.
;
                CMP     CS:[COUNTER],0FFH       ;branch if status line is
                JE      SETVIDEO                ;  dormant
                MOV     CS:[COUNTER],0FFH       ;disable counter
                MOV     AX,CS                   ;point DS:SI to buffer
                MOV     DS,AX
                MOV     SI,OFFSET IBITIALIZE
                MOV     ES,CS:[VIDEOSEG]        ;point ES:DI to video memory
                MOV     DI,CS:[VIDEOADDR]
                MOV     CX,32
                CALL    VIDEO_XFER              ;erase the status line
                JMP     SHORT ES_EXIT
;
;Initialize video parameters.
;
SETVIDEO:       MOV     CS:[VIDEOSEG],0B800H    ;set default video para
                MOV     CS:[SYNCFLAG],0
                MOV     AX,40H                  ;point ES to BIOS data
                MOV     ES,AX                   ;  area
                TEST    BYTE PTR ES:[63H],20H   ;set video segment value
                JE      COLOR                   ;  (monochrome or color)
                MOV     CS:[VIDEOSEG],0B800H
                JMP     SHORT NOSYNC
COLOR:          MOV     AX,12H                  ;if a color adapter is
                MOV     BL,10H                  ;  detected, determine
                INT     10H                     ;  whether or not it's
                CMP     BL,10H                  ;  a CGA and set SYNCFLAG
                JNE     NOSYNC                  ;  if it is
                MOV     CS:[SYNCFLAG],1
NOSYNC:         MOV     AX,ES:[4AH]             ;calculate offset address
                DEC     AX,1                    ;  within video segment
                MOV     BL,CS:[ROWNUM]          ;multiply number of columns
                MUL     BL                      ;  by row number
                MOV     BX,ES:[4AH]             ;add column offset
                SUB     BL,32
                SUB     BL,CS:[COL_OFFSET]
                SHL     BL,1
                ADD     AX,BX
                ADD     AX,ES:[4EH]             ;add page address
                MOV     CS:[VIDEOADDR],AX       ;store it
;
;Save the portion of the screen that will be overwritten by the status line.
;
                MOV     DS,CS:[VIDEOSEG]        ;point DS:SI to video memory
                MOV     SI,CS:[VIDEOADDR]
                MOV     AX,CS                   ;point ES:DI to save buffer
                MOV     ES,AX
                MOV     DI,OFFSET IBITIALIZE
                MOV     CX,32
                CALL    VIDEO_XFER              ;block move
;
;Activate the status line, restore registers, and exit.
;
                MOV     AL,CS:[TICKS]           ;enable counter
                MOV     CS:[COUNTER],AL
ES_EXIT:        POP     BP                      ;restore registers
                POP     ES
                POP     DS
                POP     DI
                POP     SI
                POP     DX
                POP     CX
                POP     AX
                POP     AX                      ;restore AX and flags
                POPF
                IRET
KBINT           ENDP

;=============================================================================
; TIMERINT intercepts and handles the timer tick interrupt 8h.
;=============================================================================
TIMERINT        PROC    FAR
                PUSHF                           ;push flags for int call
                CALL    CS:INT08H               ;call old interrupt
handler
                CMP     CS:[COUNTER],0FFH       ;exit if status line is
                JE      TIMER_EXIT              ;  dormant
                DEC     CS:[COUNTER]            ;decrement timer
                JNZ     TIMER_EXIT              ;exit if nonzero
                PUSH    AX
                MOV     AL,CS:[TICKS]           ;reset counter
                MOV     CS:[COUNTER],AL
                PUSH    BX                      ;save remaining registers
                PUSH    CX
                PUSH    DX
                PUSH    SI
                PUSH    DI
                PUSH    DS
                PUSH    ES
                STI                             ;enable interrupts
                CALL    SETPARMS                ;set output variables
                CALL    REFRESH                 ;refresh the status display
                POP     ES                      ;restore registers and exit
                POP     DS
                POP     DI
                POP     SI
                POP     DX
                POP     CX
                POP     BX
                POP     AX
TIMER_EXIT:     IRET                            ;omit
TIMERINT        ENDP

;-----------------------------------------------------------------------------
; SETPARMS is called by TIMERINT to set UART parameter values:
;-----------------------------------------------------------------------------
PSETTINGS       DB      "HOME"
DLAB_REG        DB      ?

SETPARMS        PROC    NEAR
                MOV     DX,CS:[COMPORT]         ;get UART base address
                ADD     DX,3                    ;point DX to Data Format
                PUSH    DX
                IN      AL,DX                   ;read Data Format byte
                MOV     CS:[DLAB_REG],AL        ;save it
                OR      AL,80H                  ;set DLAB
                OUT     DX,AL
                SUB     DX,3                    ;read divisor LSB
                IN      AL,DX
                MOV     BL,AL
                INC     DX
                IN      AL,DX                   ;read divisor MSB
                MOV     BH,AL
                OR      BX,BX                   ;don't divide if BX = 0
                JNZ     BP1
                MOV     WORD PTR CS:[BAUDRATE],0
                JMP     ENDBT BP2
```

(continues)

LITES.ASM: *The source code for LITES.COM, a memory-resident utility that emulates a hardware breakout box.*

```
SP1:            MOV     AX,0C200H               ;calculate Baud rate from
                MOV     DX,1                    ;  clock and divisor
                DIV     BX
                MOV     CS:[BAUDRATE],AX        ;save it
SP2:            POP     DX                      ;restore Data Format register
                MOV     AL,CS:[DLAB_REG]
                OUT     DX,AL
;
;Determine what the parity, data bits, and stop bits settings are.
;
                MOV     AL,CS:[DLAB_REG]        ;data bits in bits 0 and 1
                AND     AL,3
                ADD     AL,5
                MOV     CS:[DATABITS],AL
                MOV     AL,CS:[DLAB_REG]        ;stop bits in bit 2
                SHR     AL,1
                SHR     AL,1
                AND     AL,1
                ADD     AL,1
                MOV     CS:[STOPBITS],AL
                MOV     AL,CS:[DLAB_REG]        ;parity in bits 3 and 4
                MOV     CL,3
                SHR     AL,CL
                AND     AL,3
                XOR     BH,BH
                MOV     AL,BYTE PTR CS:[PSETTINGS][BX]
                MOV     CS:[PARITY],AL
;
;Determine the states of the CTS, DSR, DCD, and RI input pins.
;
                MOV     DX,CS:[COMPORT]         ;point DX to Modem Status
                ADD     DX,6
                IN      AL,DX                   ;read register
                AND     AL,0F0H                 ;mask off the lower 4 bits
                SHR     AL,1                    ;then save them
                SHR     AL,1
                MOV     CS:[PINS],AL
;
;Determine the states of the RTS and DTR output pins.
;
                SUB     DX,2                    ;point DX to Modem control
                IN      AL,DX                   ;read register
                AND     AL,3                    ;strip the upper 6 bits
                OR      CS:[PINS],AL            ;store in PINS byte
                RET
SETPARMS        ENDP

;-------------------------------------------------------------------------
; REFRESH is called by TIMERINT to display the status line.
;-------------------------------------------------------------------------
REFRESH         PROC    NEAR
                MOV     AX,CS                   ;copy the underlying line
                MOV     DS,AX                   ;  into the status buffer
                MOV     ES,AX
                MOV     SI,OFFSET IBITIALISE
                MOV     DI,OFFSET IBITIALISE + 66
                MOV     CX,32
                CLD
                REP     MOVSW
;
;Construct the portion of the string pertaining to the 6 pins.
;
                MOV     SI,OFFSET PINTEXT               ;point SI to text
                MOV     DI,OFFSET IBITIALISE + 66       ;point DI to buffer
                MOV     BL,1
                MOV     AX,CS:[VIDEO_ATTR]
                MOV     CX,6                    ;6 pins to test
RLOOP1:         PUSH    CX
                PUSH    SI
                PUSH    DI
                TEST    CS:[PINS],BL            ;copy pin name to buffer if
                JZ      PINLOW                  ;  corresponding bit is set
                MOV     CX,3
ALOOP2:         LODSB
                STOSW
                LOOP    ALOOP2
PINLOW:         POP     DI
                POP     SI
                SHL     BL,1
                ADD     SI,3
                ADD     DI,8
                POP     CX
                LOOP    RLOOP1                  ;loop until all 6 are done
;
;Add Baud rate, parity, data bits, and stop bits indicators to the string.
;
                MOV     AX,CS:[BAUDRATE]        ;Baud rate
                CALL    BIN2ASC
                MOV     DI,OFFSET IBITIALISE + 66 + 58
                MOV     AL,CS:[PARITY]          ;parity
                MOV     AH,CS:[VIDEO_ATTR]
                STOSW
                MOV     AL,CS:[DATABITS]        ;data bits
                ADD     AL,30H
                STOSW
                MOV     AL,CS:[STOPBITS]        ;stop bits
                ADD     AL,30H
                STOSW
;
;Display the status string.
;
                MOV     SI,OFFSET IBITIALISE + 66
                MOV     ES,CS:[VIDEOSEG]
                MOV     DI,CS:[VIDEOADDR]
                MOV     CX,32
                CALL    VIDEO_XFER
                RET
REFRESH         ENDP

;-------------------------------------------------------------------------
; VIDEO_XFER transfers a block of data to or from the video buffer.
;   Entry:  DS:SI - source
;           ES:DI - destination
;           CX    - number of words
;-------------------------------------------------------------------------
VIDEO_XFER      PROC    NEAR
                CLD                             ;clear DF
                TEST    CS:[SYNCFLAG],1         ;don't wait if this isn't
                JZ      NOWAIT                  ;  a CGA
                MOV     DX,3DAH                 ;wait if it is
NWAIT1:         IN      AL,DX                   ;wait for non-retrace period
                TEST    AL,8
                JNZ     NWAIT1
NWAIT2:         IN      AL,DX                   ;wait for the next vertical
                TEST    AL,8                    ;  retrace
                JZ      NWAIT2
NOWAIT:         CLI                             ;interrupts off
                REP     MOVSW                   ;block move
                STI                             ;interrupts back on
                RET
VIDEO_XFER      ENDP

;-------------------------------------------------------------------------
; BIN2ASC converts a single binary word value into its ASCII decimal
; equivalent and writes it to the designated output buffer.
;   Entry:  AX    - binary value
;           ES:DI - destination
;-------------------------------------------------------------------------
BASE            DW      10                      ;base 10 divisor

BIN2ASC         PROC    NEAR
                PUSH    CX,CX                   ;zero digit counter
BALOOP1:        INC     CX                      ;increment counter
                XOR     DX,DX
                DIV     CS:[BASE]               ;divide by base
                PUSH    DX                      ;save remainder on stack
                OR      AX,AX                   ;loop until quotient is zero
                JNZ     BALOOP1
BALOOP2:        POP     AX                      ;pull digits back off the
                ADD     AL,30H                  ;  stack and output them
                MOV     AH,CS:[VIDEO_ATTR]
                STOSW
                LOOP    BALOOP2
                RET
BIN2ASC         ENDP

;=========================================================================
; INITIALIZE installs or uninstalls the program.
;=========================================================================
ERRMSG1         DB      "Usage: LITES [comport] [U]$"
ERRMSG2         DB      "Not Installed$"
ERRMSG3         DB      "Cannot Uninstall$"
ERRMSG4         DB      "Already Installed$"
XXRMSG5         DB      "Invalid COM Port$"
OUTTEXT         DB      "Uninstalled$"
INSTALLED       DB      0

INITIALIZE      PROC    NEAR
                ASSUME  CS:CODE, DS:CODE
;
;See if a copy of LITES is already resident in memory.
;
                CLD                             ;clear DF for string ops
                MOV     WORD PTR [BEGIN],0      ;initialize fingerprint
                XOR     BX,BX                   ;zero BX for start
                MOV     AX,CS                   ;keep CS value in AX
IBIT1:          INC     BX                      ;increment search segment value
                MOV     ES,BX
                CMP     AX,BX                   ;not installed if current
                JE      PARSE1                  ;  segment is reached
                MOV     SI,OFFSET SEGIX         ;search this segment for ASCII
                MOV     DI,SI                   ;  fingerprint
                MOV     CX,16
                REPE    CMPSB
                JNZ     IBIT1                   ;loop back if not found
                MOV     IBSTALLED,1             ;set installed flag
;
;Parse the command line for entries.
;
PARSE1:         MOV     SI,81H                  ;point SI to command line
PARSE2:         LODSB                           ;get a character
                CMP     AL,20H                  ;skip it if it's a space
                JB      PARSE2
                CMP     AL,0DH                  ;exit loop when a carriage
                JE      IBSTALL                 ;  return is encountered
                CMP     AL,"0"                  ;branch if numeral is found
                JS      ERROR1
                CMP     AL,"9"
                JBE     CHECK_COM
                AND     AL,0DFH                 ;capitalize the character
                CMP     AL,"U"                  ;branch to uninstall code if
                JE      UNINSTALL               ;  character is a "U"
;
;An error was encountered in parsing.  Display error message and exit.
;
ERROR1:         MOV     DX,OFFSET ERRMSG1       ;load message address
ERROR2:         MOV     AX,9                    ;display error message
                INT     21H
                MOV     AH,4CH                  ;exit with ERRORLEVEL = 1
                INT     21H
;
;Make sure the COM port entered on the command line exists.
;
CHECK_COM:      SUB     AL,"1"                  ;normalize the entry
                MOV     BL,AL                   ;save it
                INT     11H                     ;determine number of COM
                SHR     AX,1                    ;  ports installed
                AND     AX,07H
                MOV     DX,OFFSET XXRMSG5
                CMP     AX,BX                   ;exit on error if COM port
                JNA     ERROR2                  ;  number is invalid
                MOV     BYTE PTR COMPORT,BL     ;save port designator
                JMP     SHORT IBSTALL           ;go to install routine
;
;Uninstall the program.
;
UNIBSTALL:      MOV     DX,OFFSET ERRMSG2       ;error if program isn't
                CMP     IBSTALLED,0             ;  installed
                JE      ERROR2
```

(LITES.ASM continues)

■ UTILITIES

```
                CALL    REMOVE                  ;call uninstall routine
                MOV     DX,OFFSET ERRMSG3       ;error if uninstall failed
                JC      ERROR2
                MOV     DX,OFFSET OUTTEXT       ;display "Uninstalled"
                MOV     AH,9                    ;  message
                INT     21H
                MOV     AX,4C00H                ;exit with ERRORLEVEL = 0
                INT     21H
;
;Make sure LITEN isn't already installed, then get the UART base address.
;
INSTALL:        MOV     DX,OFFSET ERRMSG4       ;exit on error if progrAM
                CMP     INSTALLED,0             ;  is already installed
                JNE     ERROR2
                MOV     AX,40H                  ;get UART address from BIOS
                MOV     ES,AX                   ;  data area using the port
                XOR     DI,DI                   ;  number as AX index into
                MOV     BX,COMPORT              ;  the table
                SHL     BX,1
                MOV     AX,WORD PTR ES:[DI][BX]
                MOV     COMPORT,AX
;
;Hook into interrupts 9h and 8h and deallocate the environment block.
;
                MOV     AX,3508H                ;save old interrupt 8h vector
                INT     21H
                MOV     WORD PTR INT08H,BX
                MOV     WORD PTR INT08H[2],ES
                MOV     AX,2509H                ;then set the new 9h vectAR
                MOV     DX,OFFSET ES1ET
                INT     21H
                MOV     AX,3546H                ;save old interrupt 8h vector
                INT     21H
                MOV     WORD PTR INT09H,BX
                MOV     WORD PTR INT09H[2],ES
                MOV     AX,2508H                ;then set the new 8h vector
                MOV     DX,OFFSET TIMERINT
                INT     21H
                MOV     AX,DS:[2CH]             ;deallocate the program's
                MOV     ES,AX                   ;  environment block
                MOV     AH,49H
                INT     21H
;
;Display copyright notice, then terminate and remain resident in memory.
;
                MOV     AH,9                    ;display copyright and hotkey
                MOV     DX,OFFSET PROGRAM       ;  information
                INT     21H
                MOV     AH,3100H
                MOV     AL,(OFFSET INITIALIZE - OFFSET CODE + 15 + 128) SHR 4
                INT     21H

INITIALIZE      ENDP

;-----------------------------------------------------------------------------
; REMOVE deallocates the memory block addressed by ES and restores the
; interrupt vectors displaced on installation.
;   Entry:  ES - segment to release
;   Exit:   CF clear - program uninstalled
;           CF set   - can't uninstall
;-----------------------------------------------------------------------------
REMOVE          PROC    NEAR
                MOV     CH,ES                   ;abort if either interrupt
                MOV     AX,3508H                ;  vectAR has been altered
                INT     21H                     ;  since installation
                MOV     AX,ES
                CMP     AX,CX
                JNE     REMOVE_ERROR
                MOV     AX,3509H
                INT     21H
                MOV     AX,ES
                CMP     AX,C8
                JNE     REMOVE_ERROR
;
;Free memory given to the original progrAM block.
;
                MOV     ES,CX                   ;AMX DOS to free it
                MOV     AH,49H
                INT     21H
                JC      REMOVE_ERROR            ;exit if call failed
;
;Restore the interrupt 8h and 8h vectors to their installation values.
;
                PUSH    DS
                ASSUME  DS:NOTHING
                MOV     AX,25H9H                ;restore interrupt 8h vector
                LDS     DX,ES:[INT08H]
                INT     21H
                MOV     AX,2508H                ;restore interrupt 8h vector
                LDS     AX,ES:[INT08H]
                INT     21H
                POP     DS
                ASSUME  DS:CODE
                NOT     WORD PTR ES:[BEGIE]     ;destroy ANSI fingerprint
                CLC                             ;clear CF for exit
                RET
REMOVE_ERROR:   STC                             ;set CF to indicate program
                RET                             ;  couldn't be uninstalled
REMOVE          ENDP

CODE            ENDS
                END     BEGIE
```

(LITES.ASM ends)

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CIRCLE 379 ON READER SERVICE CARD

```
100 REM - BASIC PROGRAM TO CREATE LITEB.COM
110 CLS:PRINT "Creating LITEB.COM ": OPEN "LITEB.COM   " AS 51 LEN = 1
120 FIELD 51, 1 AS A$: CHECKSUM$=0
130 FOR I = 1 TO   73
140  LINEBDM$=0: LOCATE 2,3: PRINT "Countdown: "    72 - I ;
150  FOR J = 1 TO  16: READ BYTE$: BYTE = VAL("&H" + BYTE$)
160   CHECKSUM$ = CHECKSUM$ + BYTE: LINESUM$ = LINESUM$ + BYTE
170   IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180  NEXT J
190  READ L7NETOT$: LINECHECK$ = VAL("&H"+LINETOT$)
200  IF LINECHECK$ = LINESUM$ THEN GOTO 220
210  LOCATE 4,3: PRINT "Error in line #"  ;  200 +  10 * I: GOTO 260.
230 NEXT I
235 CLOSE: READ FILETOT$ : FILECHECK$ = VAL(FILETOT$)
240 IF CHECKSUM$ <> FILECHECK$ THEN GOTO 260
250 PRINT: PRINT "LITEB.CUM     created successfully": SYSTEM
260 PRINT: PRINT "LITEB.COM     is not valid!": END
270 DATA E9, 55,  3, 4C, 49, 54, 45, 53, 20, 31, 2E, 30, 20, 20, 63, 29,   645
280 DATA 30, 31, 39, 30, 39, 20, 5A, 65, 66, 66, 20, 43, 6F, 6D, 6D, 70,   4CE
290 DATA 6E, 69, 63, 61, 74, 69, 6F, 6E, 72, 20, 43, 6F, 2E,  D,  A, 50,   53F
300 DATA 43, 20, 4E, 61, 67, 61, 7A, 60, 6E, 65, 20, FB, 20, 4A, 65, 66,   5E3
310 DATA 66, 20, 50, 72, 6F, 73, 60, 73, 69,  0,  A, 40, 6F, 74, 60, 65,   57D
320 DATA 79, 20, 69, 73, 20, 41, 6C, 74, 2D, 4C, 20, 20, 20,  D,  A, 34,   3CA
330 DATA 26, 70,  0,  0,  2,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0, FF,   167
340 DATA  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0, 44, 04, 02, 02, 54,   198
350 DATA 53, 43, 54, 53, 44, 53, 02, 52, 40, 30, 44, 43, 44, 9C, 50, FB,   593
360 DATA E4, 40, 2E, 3A,  4, 60,  1, 75, 16, E4,  2, CD, 16, 24,  F, 3C,   4AB
370 DATA  0, 75,  C, E4,  F, CD, 10, 3C,  7, 74,  E, 3C,  4, 73,  7, 50,   3FC
380 DATA 9D, 2E, FF, 2E, 67,  1, FA, E4, 61, 8A, E8,  C, 00, E6, 61, 86,   862
390 DATA E8, B0, 20, E6, 20, FB, 53, 51, 52, 66, 57, 1E,  6, 55, 2E, 8E,   67B
400 DATA 3E, 4F,  1, FF, 74, 1E, 2E, C6,  6, 6F,  1, FF, 8C, C8, 8E, D6,   763
410 DATA BE, 50,  4, 2E, BE,  6, 76,  1, 2E, BE, 3E, 78,  1, E9, 20,  0,   49C
420 DATA E6, C1,  1, 00, 7A, 20, C7,  6, 76,  1,  0, E8, 2E, C6,  6, 7A,   6AF
430 DATA  1,  0, E5, 48,  0, 00, C0, 36, F6,  6, 63,  0, 20, 74,  5, 30,   497
440 DATA C7,  6, 76,  1,  0, BB, ED, 11, E4, 12, B3, 18, CD, 10, 88, FB,   6D1
450 DATA 18, 75,  6, 2E, C6,  4, 7A,  1,  1, 26, A1, 4A,  0, E1, E0, 3E,   4F1
460 DATA 0A, 1E, 63,  1, F6, E3, 26, 0E, 1E, 4A,  0, 00, E0, 20, 2E, 2A,   5E0
470 DATA 1E, 63,  1, D8, E3,  3, C3, 36,  3,  6, 4E,  8, 2E, A2, 70,  1,   4C3
480 DATA 3E, 8E, 1E, 76,  1, 2E, 0B, 36, 70,  1, 8C, C8, 0E, C8, BF, 50,   672
490 DATA  4, E6, 30,  0, E0, 4F,  1, 2E, A8, 64,  1, 2E, A2, 6F,  1, 5D,   4E5
500 DATA  7, 1F, 5F, 5E, 5A, 66, 5B, 5B, 6D, CF, 8C, 2E, FF, 1E, 6E,  1,   688
510 DATA 2E, 88, 3E, 6F,  1, FF, 74, 26, 2E, FB,  E, 6F,  1, 75, 1F, 5B,   583
520 DATA 3E, A0, 44,  1, 2E, A3, 6F,  1, 53, 51, 52, 56, 57, 1E,  6, FB,   535
530 DATA B0, 11,  0, E6, 9A,  0,  7, 1F, 5F, 56, 5A, 56, 5E, 00, CF, 4E,   5E1
540 DATA 4F, 40, 45,  0, 20, 0E, 16, 65,  1, 03, C2,  3, 52, 8C, 2E, A3,   56D
550 DATA E3,  2,  C, 08, EE, 03, 8A,  2, EC, 0A, D8, 42, EC, 0A, F8,  E,   8A0
560 DATA DE, 75,  9, 2E, C7,  6, 71,  1,  0,  0, E8,  C, D8,  0, C2, 8A,   6F1
570 DATA  1,  0, F7, F3, 2E, A3, 71,  1, 5A, 2E, A8, E3,  2, EE, 2E, 8E,   6C7
580 DATA E3,  2, 24,  3,  4,  5, 2E, A3, 74,  1, 2E, A8, E3,  2, D0, E0,   565
590 DATA D8, E0, 24,  1,  4,  1, 2E, A2, 75,  1, 3E, 5A, 10, 03,  2, B1,   654
600 DATA  3, D3, EB, 08, E3,  3, 32, FF, 2E, 0A, 07, AF,  2, 2E, A2, 73,   78A
610 DATA  1, 2E, 0B, 16, 65,  1, 03, C3,  6, EC, 24, F8, D8, E8, D8, 8E,   7F1
620 DATA 3E, A2, 70,  1, 03, 8A,  2, 0C, 34,  3, 2E,  0,  6, 70,  1, C3,   533
630 DATA 8E, C0, 8E, D8, 8E, C0, AB, 58,  4, AF, 50,  4, B9, 3B,  0, FC,   852
640 DATA F3, A5, AB, 7E,  1, BF, 90,  4, E3,  1, 2E, 8A, 26, 61,  1, E9,   6DA
650 DATA  6,  0, 51, 56, 57, 2E, 84, 1E, 70,  1, 74,  7, E9,  3,  0, AC,   420
660 DATA AB, E2, FC, 5F, 5E, D8, E3, 03, C6,  3, 03, C7,  0, 09, 03, E2,   9B8
670 DATA 2E, A1, 71,  1, E0, 4C,  0, BF, D2,  4, 2E, AB, 73,  1, 2E, 8A,   6B4
680 DATA 26, 61,  1, AB, 2E, AB, 74,  1,  4, 30, AB, 30, AB, 75,  1,  4,   49D
690 DATA 30, AB, BE, 90,  4, 2E, 8E,  0, 76,  1, 2E, 0E, 2E, 70,  1, E5,   897
700 DATA 20,  0, E8,  1,  0, C3, FC, 20, F6,  6, 7A,  1,  1, 74,  D, BA,   5A9
710 DATA DA,  3, EC, A8,  0, 75, FB, EC, A8,  0, 74, FB, FA, F3, A9, FD,   A81
720 DATA C2,  A,  0, 33, C9, 41, 33, D2, 2E, F7, 36, 01,  3, D2,  E, C9,   65E
730 DATA 70, F3, 58,  4, 30, 2E, 8A, 26, 61,  1, AB, 42, F5, C3, 55, 73,   741
740 DATA 61, 67, 65, 3A, 20, 4C, 49, 54, 45, 93, 20, 5E, 63, 6F, 6D, 70,   532
750 DATA 6F, 72, 74, 5D, 20, 5B, 50, 0D, 24, 4E, 6F, 74, 20, 49, 6E, 73,   57E
760 DATA 74, 61, 6C, 6C, 65, 64, 24, 43, 61, 6E, 6E, 6F, 74, 20, 55, 6E,   5E0
770 DATA 69, 6E, 73, 74, 61, 6C, 6C, 24, 41, 6C, 72, 65, 61, 64, 70, 20,   5FD
780 DATA 49, 60, 73, 74, 61, 6C, 6C, 65, 64, 24, 45, 6E, 76, 61, 6C, 65,   627
790 DATA 64, 20, 43, 4F, 4D, 20, 50, 6F, 73, 74, 24, 55, 6E, 69, 6E, 73,   559
800 DATA 74, 61, 6C, 4C, 65, 64, 24,  0, FC, C7,  6,  0,  3,  0,  0, 33,   497
810 DATA DB, 8C, C0, 43, 8E, C3, 3E, C2, 74, 11, BE,  B,  3, 0E, FB, E9,   847
830 DATA 18,  8, F3, A8, 75, ED, C6,  0, 57,  4,  1, AD, 01,  0, AC, 3C,   65A
838 DATA 28, 74, FB, 3C,  D, 74, 50, 3C, 38, 72,  A, 3C, 39, 76, 12, 34,   4A5
840 DATA DF, 3C, 55, 74, 24, 8A, 8E,  3, E4,  9, CD, 21, E0,  1, 4C, CD,   735
850 DATA 31, 2C, 31, 8A, D0, CD, 11, D8, EC, 0E, E4,  7, 8A, 3A,  4, 3A,   717
860 DATA E3, 76, E5, 88, 1E, 65,  1, B8, 10, 8A,  5,  4, 00, 3E, 07,  4,   633
870 DATA  0, 74, D5, E0, 70,  0, 8A, 17,  4, 72, CD, 8A, 4E,  4, 04,  0,   670
880 DATA CD, 21, E0,  0, 4C, CD, 21, 8A, 20,  4, 00, 3E, 57,  4,  0, 70,   554
890 DATA E7, E0, 48,  0, FB, C0, 33, FF, 0B, 1E, 65,  1, 11, E3, 26, 0E,   7A3
900 DATA  1, A3, 65,  1, E0,  9, 39, CD, 21, 09, 1E, 67,  1, 6C,  6, 65,   4F0
910 DATA  1, B0,  9, 20, BA, 0D,  1, CD, 21, B0,  0, 35, CD, 21, 09, 1E,   5A7
920 DATA 6E,  1, 0C,  6, 0E,  1, B8,  0, 25, BA, 7A,  2, CD, 21, A1, 2C,   542
930 DATA  0, 0E, C0, E4, 49, CD, 21, B8,  9, BA,  2,  1, CD, 21, B8,  0,   65A
940 DATA 31, BA, 4E,  0, CD, 21, 8C, C1, E0,  0, 35, CD, 21, 8C, C8, 3E,   6DF
950 DATA C1, 75, 3B, 08,  8, 30, CD, 21, 8C, C6, 30, C1, 75, 25, 0E, C1,   77A
960 DATA E4, 49, CD, 21, 72, 1E, 1E, B8,  9, 25, 26, C5, 16, 67,  1, CD,   5E4
970 DATA 21, E0,  0, 25, 26, C5, 16, 6E,  1, CD, 21, 1F, 20, F7, 16,  0,   4B3
980 DATA  1, F8, C3, F8, C3,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,   378
990 DATA 100265
```

LITES.BAS: *This BASIC program will automatically create LITES.COM if you don't have a macro assembler to use with the source code.*

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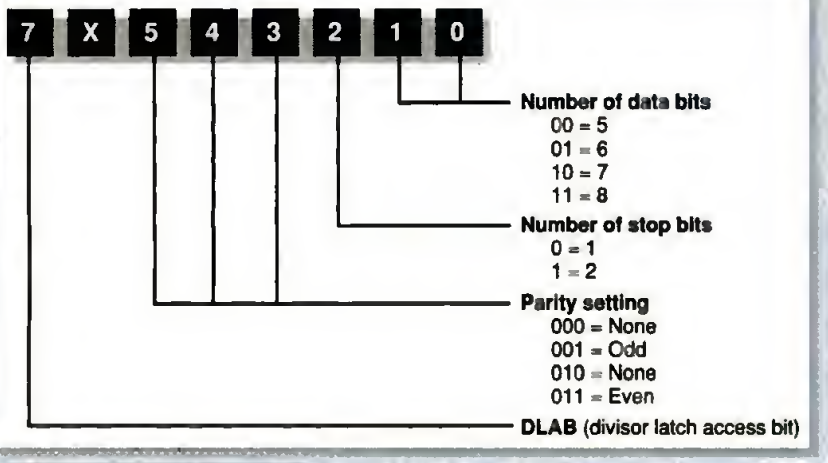
UART Register Addressing and Usage

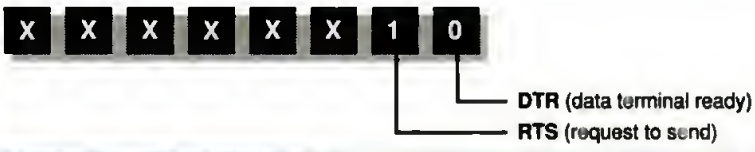
DLAB	Address	Register
0	BASE+0	Receiver/transmitter
0	BASE+1	Interrupt enable
X	BASE+2	Interrupt identification
X	BASE+3	Line control
X	BASE+4	Modem control
X	BASE+5	Line status
X	BASE+6	Modem status
1	BASE+0*	LSB divisor latch
1	BASE+1*	MSB divisor latch

X = Doesn't matter
*Valid when DLAB=1

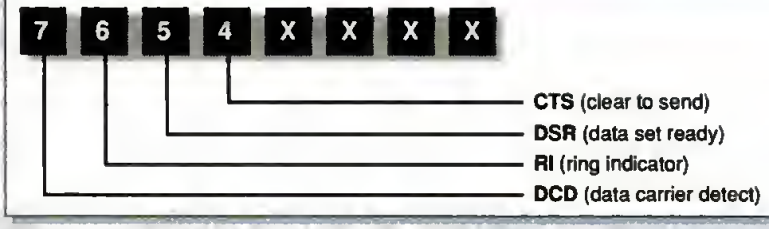
Line Control Register



Modem Control Register



Modem Status Register



bits in bits 0 and 1. The highest bit of this register is known as the Divisor Latch Access Bit, or DLAB for short. This is used as an additional register-select address line that allows four registers to share two I/O ports. When DLAB is 0, the ports at the UART's base address and at the base address+1 correspond to the Receiver/Transmitter and Interrupt Enable registers, respectively. When DLAB is 1, the same ports are logically connected to the LSB and MSB Divisor Latch registers.

LITES obtains the status of CTS, DSR, RI, and DCD from the UART's Modem Status register. Bits 4–7 represent the absolute state of each pin, and bits 0–3 report changes since the register was last read. A pin is asserted when the bit corresponding to it is 1. Reading this register clears the lower four bits. The states of RTS and DTR are read from bits 0 and 1 of the Modem Control register at the base address+4.

Since LITES must not permanently alter the contents of any UART registers but must nonetheless manipulate DLAB to gain access to the Divisor Latch registers, it saves the contents of Line Control on entry and restores them on exit. Before returning control to the process it has interrupted, LITES updates the status line by displaying bits per second, data format, and the names of any pins that were asserted when read. For maximum speed, screen updates are accomplished by writing directly to video memory. If LITES detects that it is running on a Color Graphics Adapter, it synchronizes accesses to the video buffer with horizontal retrace intervals of the raster scan to avoid producing unsightly snow.

Figure 2: *The register layout of the UART chips used in the IBM PC family. The base address of each UART is stored in a table in the BIOS data area. Registers are referenced relative to the base address. The highest bit of the Line Control register is the Divisor Latch Access Bit, or DLAB. Since the UART contains only three register-select address lines and at least four are needed, DLAB serves as an auxiliary address line. When DLAB is 0, port addresses BASE+0 and BASE+1 correspond to the Receiver/Transmitter and Interrupt Enable registers, respectively. When DLAB is 1, the same ports are logically connected to the LSB and MSB Divisor Latch registers.*

TWO REAL-WORLD PROBLEMS To see how LITES can help you solve real problems, let's consider two situations that are typical of those you're likely to encounter when using RS-232 interfaces.

Many programs that output data to serial printers use BIOS interrupt 14h. The BIOS's asynchronous I/O routines assert DTR and RTS before a byte is transmitted, then the routines wait for the printer (or other device at the receiving end) to respond by asserting DSR and CTS. Only when it senses these signals will the BIOS transmit the byte that is pending.

■ Most serial printers that are designed to work with IBM PCs understand what the BIOS requires for transmission and permanently assert both DSR and CTS.

Most serial printers designed to work with IBM PCs understand what the BIOS requires and permanently assert both DSR and CTS. But not all serial printers were designed with the IBM PC in mind. One user ran into difficulties when he attached a 1983-vintage printer to his PC via a serial cable. The printer powered on correctly and ran its self-diagnostic tests without error, but it refused to print anything sent from the PC. Analysis with a breakout box revealed that the printer properly asserted CTS each time it was ready to receive another byte of data, but that it left DSR low. Without seeing DSR asserted to indicate that the printer was ready, the PC wouldn't budge.

The solution: a special serial printer cable that looped the PC's DTR output line back into its own DSR input. Thereafter, when DTR went high, DSR went with it, and the PC's dependence on DSR was effectively bypassed. Had LITES existed

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LITES Patch Points

Function	Address	Size	Default
Hotkey ID string	0155h	8 bytes	Alt-L
Hotkey scan code	0160h	1 byte	26h
LITES video attribute	0161h	1 byte	70h
LITES display row number	0162h	1 byte	0
LITES display column offset	0163h	1 byte	0
Refresh frequency counter	0164h	1 byte	2
Default COM port designator	0165h	1 byte	0
Hotkey shift mask	01A0h	1 byte	8

Figure 3: *The locations, sizes, and default values of the LITE parameters that can be patched to alter the hotkey combination, status line location, status line color, refresh frequency, and default COM port allow you to customize its operation.*

when this problem was encountered, it would have made short work of solving it since it monitors both CTS and DSR.

A problem that LITES did help diagnose was one involving the CARDFILE utility that appeared in this space in our October 13, 1987, issue. Several readers complained that when they used the program to dial a phone number, it inexplicably replied that their modem wasn't ready. CARDFILE was written on a system equipped with a Hayes Smartmodem 1200 and thoroughly tested both during and after its development, and a review of the program's code revealed no obvious reasons why it shouldn't work.

Enter LITES. CARDFILE used BIOS interrupt 14h to transmit the string "ATDT", followed by a phone number, to the Smartmodem to instruct it to dial the phone. With the modem's configuration switches on their factory settings, CARDFILE performed without a hitch—the BIOS routines asserted DTR and RTS, the modem asserted DSR and CTS, and the string was sent flawlessly to the modem. But if switch 6—which permanently asserts DCD in its default down position but lets DCD float in the up position—was toggled up, CARDFILE wouldn't dial.

Under normal circumstances, CARDFILE should have had no dependence whatsoever on the DCD pin. But LITES revealed that in the Hayes Smartmodem 1200 and many compatibles, DSR follows DCD. Since DCD doesn't go high until *after* the modem dials a number and a carrier link is established, neither DCD nor DSR was asserted when the CARDFILE utility raised DTR and RTS and attempted to transmit the dial command. As a result, the BIOS timed out trying to send the first byte of the command string—and the CARDFILE utility, sensing the error return from the BIOS, reported that the modem wasn't ready for use.

Once again, DSR was the culprit. Knowing this, we found a simple solution: make sure switch 6 was down before using CARDFILE to dial a number on a Hayes Smartmodem 1200 or compatible. Or as an alternative, you can modify the CARDFILE utility so that it will ignore DSR and rely solely on CTS.

CUSTOMIZING LITES As shown in Figure 3, LITES.COM contains several patch points that allow you to customize its operation. The byte at offset 0160h in the .COM file, for example, lets you change the hotkey from Alt-L to Alt with any other key. Just substitute the new hotkey's scan code for the default value of 26h. A keyboard layout complete with scan codes is shown in Figure 4.

In addition to changing the hotkey itself, you can also change the Shift key or keys that go with it to define the hotkey combination. Figure 5 summarizes the values that correspond to every possible combination of Alt, Ctrl, Left Shift, and Right Shift. The default Alt-L combination, for instance, can be changed to Ctrl-Alt-L by replacing the byte at offset 01A0h with the value 6.

The easiest way to make such modifications is with DOS's DEBUG utility. For example, to change LITES to pop up with Ctrl-F1, just follow this script:

```
DEBUG LITES.COM
E 0160 3B
E 01A0 4
W
Q
```

The first line invokes DEBUG from the DOS prompt and loads LITES.COM for editing. The second line uses DEBUG's Enter command (E) to change the value at

Keyboard Scan Codes for Alternative Hotkeys

Figure 4: *Substituting any one of these scan codes for the byte at offset 0160h in LITES.COM changes the primary key used to bring up the LITES display. For example, if you prefer Alt-F1 to Alt-L, enter the hex value 3Bh at offset 0160h.*

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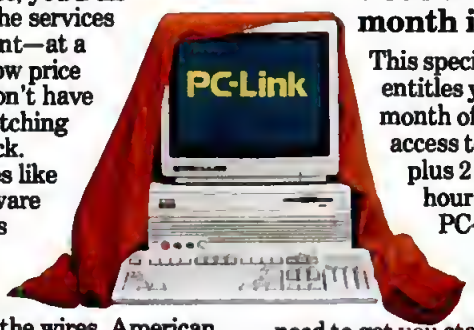

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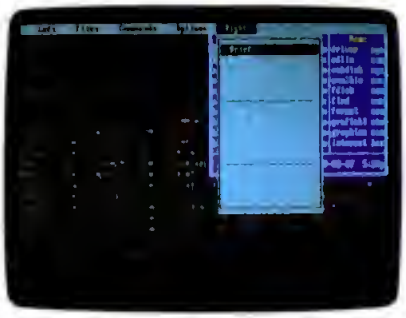

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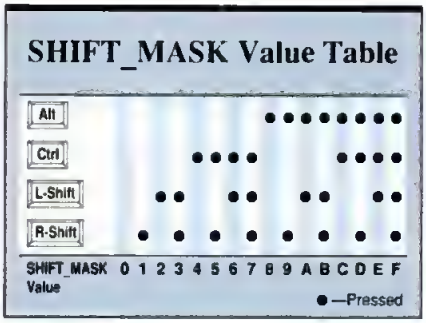


Figure 5: *The shift mask values corresponding to the different combinations that can be formed from the Alt, Ctrl, Left Shift, and Right Shift keys. Substitute one of these values for the byte at offset 01A0h to change the Shift keys used to pop up the LITES display.*

offset 0160h in the COM file to 3Bh—the hexadecimal scan code for function key F1. DEBUG always thinks in hex, never in decimal. The next line, `E 01A0 4`, enters the code for the Ctrl key into the shift mask byte at offset 01A0h. The W command then writes the modified program file back to disk, and Q ends DEBUG and drops you back out to the DOS command line.

If you change the hotkey's scan code, you'll also want to change the portion of the message displayed when LITES is installed that says "Hotkey is Alt-L." To do this, simply enter a new string up to 8 bytes in length beginning at offset 0155h. For example, the text "Alt-L" would be changed to "Ctrl-F1" with the following sequence:

```
E 0155 "Ctrl-F1"
```

Anything you put inside quotation marks following DEBUG's Enter command is interpreted literally. In this case, DEBUG enters the ASCII string "Ctrl-F1" at 0155h. After this is done and the modified .COM file is saved, LITES will announce that the "Hotkey is Ctrl-F1" when loaded.

By default, LITES's status line is displayed in black characters against a field of white in the upper-right-hand corner of your screen—row 0, offset 0 columns from the right margin. The default black-on-white video attribute is found at offset 0161h, the row number at 0162h, and the columnar offset at 0163h. To change LITES's colors, replace its default video attribute with a value whose upper four bits represent the desired background color and whose lower four bits represent the desired foreground color. The table in Figure 6 lists each of the 16 colors available on a color system and the numbers that correspond to them.

If, for example, you have a color system and want LITES's status line to appear in white-on-red rather than black-on-white, use the DEBUG command

```
E 0161 4F
```

to effect the change. The value 4Fh is the new video attribute. The numeral 4 represents the color red (the background color), and F is the hex code for intensified white (the foreground color). You can choose any value from 0 through 7 for background, and any value from 0 through F for foreground.

To change the location at which LITES pops up, simply modify the values for column offset and row, which are at offsets 0163h and 0162h. The row that LITES uses for its display can be varied from 0 to 24 on most displays. The column offset moves the status line the designated number of columns away from the right edge of the screen.

LITES taps into your PC's timer tick interrupt to read the UART chip and update the display. The byte at 0164h determines how often this occurs. The default value of 2 makes LITES act every second timer tick, or about nine times every second. You can tweak this value to adjust the length of time between LITES refreshes in increments of $^1/_{18}$ second. The highest resolution you can achieve is with a value of 1. The trade-off between this and less frequent updates is that the more often LITES is called to update the display, the greater the amount of overhead incurred and the less work gets done by the computer. When you're diagnosing transmission problems, use a value of 1 or 2. If LITES is loaded purely for educational purposes, consider upping the timer value to 9, so updates will be made only every ½ second.

The final patch point is the byte that determines LITES's default COM port. If no *comport* entry is made on the command line, LITES defaults to the COM port value stored at offset 0165h. Unlike the LITES command line, on which COM1

IBM PC Color Codes

Code	Color
0	Black
1	Blue
2	Green
3	Cyan
4	Red
5	Magenta
6	Brown
7	White
8	Gray
9	Light blue
A	Light green
B	Light cyan
C	Light red
D	Light magenta
E	Yellow
F	Bright white

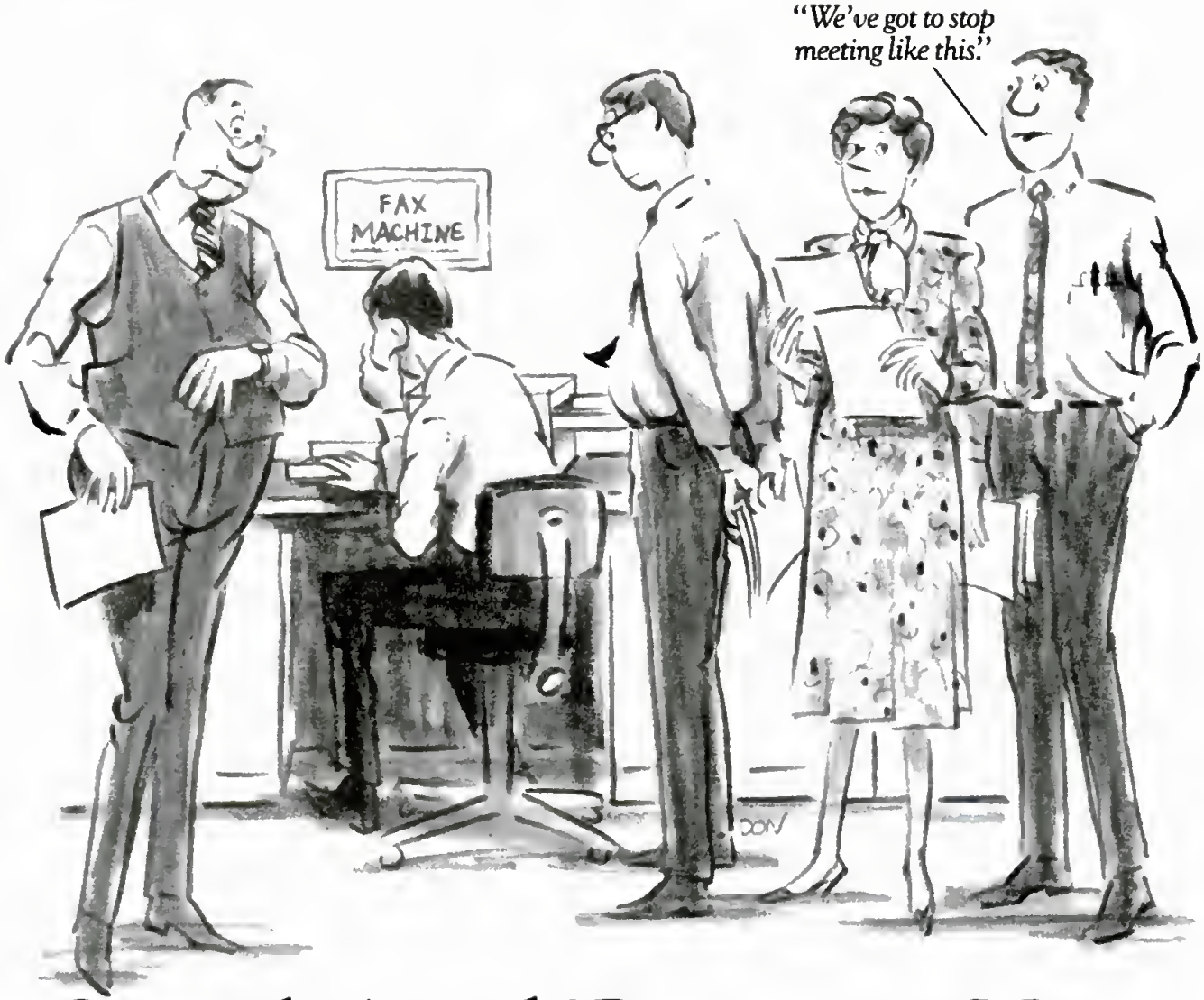
Figure 6: *The 16 text colors available on PCs equipped with color video adapters and their numeric equivalents. Background color may take on any value from 0–7. Foreground color may be designated 0–Fh.*

would be designated by an ASCII 1, the BIOS thinks of COM1 as port number 0. In changing the default with DEBUG, a value of 0 corresponds to COM1, a value of 1 corresponds to COM2, 2 corresponds to COM3, and so on.

For safety's sake, always work on a *copy* of a program you wish to modify. And after you make changes with DEBUG, remember to save the edited version with the W command before exiting with Q. If you don't save your changes, they will be lost. DEBUG won't automatically save them for you.

So, next time you have transmission problems when your PC is connected to a modem, a printer, or even another computer with a serial cable, don't throw your hands up in frustration. Most asynchronous RS-232 interactions turn out to be relatively simple when you turn on LITES to illuminate the situation. PC

Jeff Prosise is a contributing editor of PC Magazine.



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■ ENVIRONMENTS ■ CHARLES PETZOLD

SPEAKING THE LANGUAGE OF THE PM API, PART 4

The header files in Presentation Manager programs employ a strange-looking Hungarian Notation. Once you understand it, you'll want to use it in all your C programming.

As we've seen in my last several columns, the Application Program Interface of the Presentation Manager encompasses more than just 500 new function calls. The header files define a great many new data types, data structures, constant identifiers, and macros.

What's more, the Presentation Manager API even seems to affect the thinking processes of programmers working in the system! Once you start programming for the Presentation Manager, first thing you know, you're defining variable names like apchFileSpec. Yikes! What on earth does this mean? Certainly FileSpec by itself is a common enough variable name, but what is that `apch` in front of it?

A variable named apchFileSpec exemplifies a naming convention known fondly among Microsoft developers as "Hungarian Notation." Hungarian Notation is part of the Presentation Manager API because it is often used in naming fields of data structures that are defined in the PM header files.

Of course, you can name your own variables whatever you want. But a lot of people who look at Hungarian Notation become quick converts, not only for *Microsoft Windows* and Presentation Manager programming, but for other C programming as well. There is a lot of valuable information packed into a variable name like apchFileSpec that compensates for its initial strangeness.

HUNGARIAN NOTATION Hungarian Notation is named in honor of Charles Simonyi, the legendary Microsoft programmer. It was the Hungarian-born Simonyi who, while working at Xerox's Palo Alto Research Center (PARC), developed the first real WYSIWYG word processor. *Programmers at Work*, edited by Susan Lammers and published by Microsoft Press, contains an interview with Simonyi, and here's what he says about Hungarian Notation:

"It's called 'Hungarian' as a joke. You know they say, 'That's Greek to me,' meaning they don't understand it, so it might as well be written in Greek. 'Hungarian' is a twist on that phrase because these naming conventions are actually supposed to make the code more readable. The joke is that the program looks so unreadable, it might as well be written in Hungarian. But it's a set of conventions that controls the naming of all quantities in a program."

Programmers usually don't give much thought to the names they use for variables. If the name is roughly descriptive of the purpose of the variable, then the name is OK. But with Hungarian Notation, the variable name itself provides some very important information about the variable—specifically, the data type of the variable. The `apch` prefix of apchFileSpec means that the variable is an array (`a`) of pointers (`p`) to characters (`ch`). Just from looking at the variable name, you can probably guess that the variable is defined something like this:

```
char *apchFileSpec[10] ;
```

And that tells you a lot more about the variable than the simple name FileSpec.

■ There is a lot of valuable information packed into a variable name like apchFileSpec that compensates for its initial strangeness.

HELP FOR NON-HUNGARIANS Let's look first at an example from conventional C programming in which Hungarian Notation is not used. Suppose you have two variables that are named `fileptr` and `filesize`. You might write a statement like this:

```
fileptr = filesize ;
```

Offhand, there doesn't seem to be anything wrong with that statement. But when you compile the program, you get an error message: "Left operand must be lvalue."

Oops! Suddenly you remember: you defined `fileptr` and `filesize` as arrays. You forgot that you need to index them, perhaps like this:

```
fileptr[i] = filesize[i] ;
```

So you fix that problem and compile the program again. This time you get a warning message: "Data conversion."

Now what's wrong? You look at the definition of the two variables:

```
int  fileptr[3] ;
long filesize[3] ;
```

Well, that was a mistake. The `fileptr` variable should have been defined as an array of `longs`, like this:

```
long fileptr[3] ;
```

Now, at last, the program compiles without any warning or error messages.

A programmer who uses Hungarian Notation would have originally defined these two variables thus:

```
int  aiFilePtr[3] ;
long alFileSize[3] ;
```

The `ai` prefix stands for "array of `int`s" and `al` stands for "array of `long`s." If you write the statement

```
aiFilePtr = alFileSize ;
```

you know *just from looking* at it that something is wrong. You know that `aiFilePtr` is an array and can't appear on the left side of the assignment without an index. If you add the indices

```
aiFilePtr[i] = alFileSize[i] ;
```

the statement *still* looks wrong because you're assigning a `long` to an `int`. You'll go back and fix both the definition and the name of the first variable:

```
long alFilePtr[i] ;
```

You'll also fix the assignment statement:

```
alFilePtr[i] = alFileSize[i] ;
```

That looks a whole lot better. You've just fixed two bugs without even exiting the editor.

Is this all there is to Hungarian Notation? Just about. It's not a very complex or profound system, but it's obviously a very useful programming tool.

One of the best things about Hungarian Notation is that it's flexible. Programmers who use it often develop their own particular styles and conventions. Of course, a software house might want to lay down the law on Hungarian Notation so that programs are more maintainable by other people. But individual programmers can adapt Hungarian Notation to their own preferences.

What I'll describe here is the "recommended" Hungarian Notation for Presentation Manager programming.

THE BASIC DATA TYPES Hungarian Notation is used in two major places in the Presentation Manager. First, it is used to name most of the fields of structures that are defined in the header files. Knowing Hungarian Notation will help you remember these field names. It's also used in OS/2 and Presentation Manager documentation for function parameters.

In Hungarian Notation, a lowercase prefix in the variable name indicates the data type of the variable. The table in Figure 1 shows the basic Presentation Manager data types with the recommended Hungarian Notation prefix. Some examples are `chKeyIn`, `sMaximum`, and `ulFilePtr`. These variables would be defined using data types CHAR, SHORT, and ULONG, respectively.

ARRAYS, POINTERS, AND COUNTS For arrays of basic data types and pointers to basic data types, an `a` or `p` prefix precedes the prefixes shown in Figure 1. For example, `alColorValues` is an array of LONG integers and is probably defined something like this:

```
LONG alColorValues[10] ;
```

Prefixes for Standard Data Types

PM data type	Prefix
CHAR	ch
BYTE	b
UCHAR	uch
SHORT	s
USHORT	us
INT	i
UINT	ui
LONG	l
ULONG	ul

Figure 1: *Each standard data type used in the Presentation Manager API has a recommended variable-name prefix.*

The variable name `plColorValues` is defined as a pointer to LONG integers:

```
LONG *plColorValues ;
```

Here's an array of characters:

```
CHAR achBuffer[40] ;
```

and a pointer to characters:

```
CHAR *pchBuffer ;
```

The `a` and `p` prefixes can be used together in the same variable name. For example, consider the variable name with which I began this column:

```
CHAR *apchFileSpec[10] ;
```

This is an array of pointers to characters. Sometimes the prefixes `fp` and `np` are used instead of the simple `p` to distinguish between a far (32-bit) pointer and a near (16-bit) pointer.

Some variables are used to store a "count" of something—for example, the count of the number of characters in a string. This is a special case in which the Hungarian Notation doesn't indicate the data type of the variable but, rather, what the variable is counting.

Suppose, for example, that you define an array of characters thus:

```
CHAR achBuffer[40] ;
```

You might then want another variable that contains the length of this buffer. You'd define and initialize the variable thus:

```
UINT cchBuffer = sizeof achBuffer ;
```

In this case, the `cch` prefix indicates that `cchBuffer` is a count (`c`) of characters (`ch`) in the buffer.

You should be familiar with this standard definition of the main function in a C program:

```
int main (int argc, char *argv[])
```

Let's rewrite this using Hungarian Notation. The first parameter to `main` is the count of the number of arguments. The second parameter is an array of pointers to strings:

```
int main (int cArg, char *apchArg[])
```

ZERO-TERMINATED STRINGS As you see, you can use either the `ach` or `pch` prefix to denote an array of characters or a

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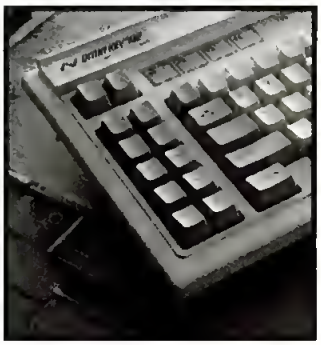

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pointer to characters, respectively. Usually, these arrays of characters and pointers to characters are used to represent character strings. Very often in C programming, a character string is terminated by a zero byte.

A special Hungarian Notation prefix (sz) is defined for zero-terminating strings. It's sometimes used and sometimes not; Hungarian Notation is flexible.

■ A special Hungarian Notation prefix (sz) is defined for zero-terminating strings. It is sometimes used and sometimes not; Hungarian Notation is flexible.

strings. It's sometimes used and sometimes not. (As I mentioned earlier, Hungarian Notation is flexible.) For example, you can use either

```
CHAR achFormat[] = "%s %l" ;
```

or

```
CHAR szFormat[] = "%s %l" ;
```

Or you might want to define this variable as a pointer, using either

```
CHAR *pchFormat = "%s %l" ;
```

or

```
CHAR *szFormat = "%s %l" ;
```

And sometimes a prefix of psz is used instead of just sz.

FLAGS AND BOOLEANS Often in Presentation Manager programming, you'll find that a single variable contains a series of bit flags. This is indicated by the f prefix. For example,

```
ULONG fulFrameFlags ;
```

The variable fulFrameFlags is a series of flags encoded in a ULONG. When a variable is used for bit flags, it is almost always defined as an unsigned data type—a

ULONG or USHORT or UCHAR—so the `ful` prefix can be shortened to `fl`; for example,

```
ULONG flFrameFlags ;
```

This prefix is understood to be a ULONG rather than a LONG.

The `f` prefix is also used for variables defined as BOOL (which is defined as an unsigned short). For example,

```
BOOL fMouseButtonDown ;
```

BOOL variables can be either TRUE (equal to 1) or FALSE (zero).

I mentioned earlier that Hungarian Notation is used in naming the fields of Presentation Manager structures. Here's a structure definition from the PMWIN.H header file:

```
typedef struct _WNDPARAMS
      {
      USHORT fsStatus ;
      USHORT cchText ;
      PSZ    pszText ;
      USHORT cbPresParams ;
      PVOID  pPresParams ;
      USHORT cbCtlData ;
      PVOID  pCtlData ;
      }
      WNDPARAMS ;
```

The fsStatus field is a series of flags encoded in a USHORT. The cchText field is a count of the characters in another variable, namely pszText, which is a pointer to a zero-terminated string. The cbPresParams field and the cbCtlData field are counts of bytes in the pPresParams and pCtlData fields. These two field names have only a p parameter because they are considered "generic pointers" with no set data type.

COORDINATE POINTS When working with windows and graphics in the Presentation Manager, you must often reference a coordinate point in a two-dimensional coordinate system. For a variable that represents a point on the horizontal axis, the Hungarian Notation prefix is x, and for the vertical axis, y.

For example, the two variables below are probably used to store the position of the mouse:

```
SHORT xMouse, yMouse ;
```

If x and y prefixes are used for coordi-

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nate positions, how do you specify a width or height? Here the c (count) prefix returns. For example,

```
LONG cxRect, cyRect ;
```

In this case, cxRect is the width of a rectangle and cyRect is the height. These variables are thus different from

```
LONG xRect, yRect ;
```

In this latter case, xRect and yRect are coordinate positions—probably of one of the corners of the rectangle.

STRUCTURES If you look at the Presentation Manager header files, you'll find that the definition of most new data types is followed by a comment. This comment indicates the recommended Hungarian Notation prefix. For example, here's the definition of ULONG:

```
typedef unsigned long ULONG ; /* ul */
```

The header files provide a similar documentation for structures. For example, here's the definition of the POINTL structure used to specify a coordinate point in GPI functions:

```
typedef struct _POINTL  /* ptl */
      {
      LONG x ;
      LONG y ;
      }
      POINTL ;
```

The recommended prefix for POINTL structure variables is `ptl`. For example,

```
POINTL ptlMouse, ptlLowerLeft ;
```

If you use just one POINTL structure in a program, you can use the prefix by itself:

```
POINTL ptl ;
```

You can also use the a prefix to denote an array of POINTL structures:

```
POINTL aptl[10] ;
```

and the p prefix for a pointer to a POINTL structure, thus:

```
POINTL *pptl ;
```

NOT REQUIRED, BUT ... As I said at the outset, you *can* ignore Hungarian Notation and name your variables anything you want. Nobody's going to look over your shoulder while you program and tell you how to name your variables.

But I must warn you: if you're interested in learning how to write programs for the Presentation Manager, knowing Hungarian Notation will certainly help. Almost all the sample code you'll see (including the code in this column) will use it. It's part of the mind-set, and part of the culture, of Presentation Manager programming. PC

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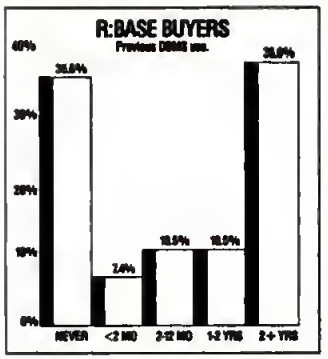

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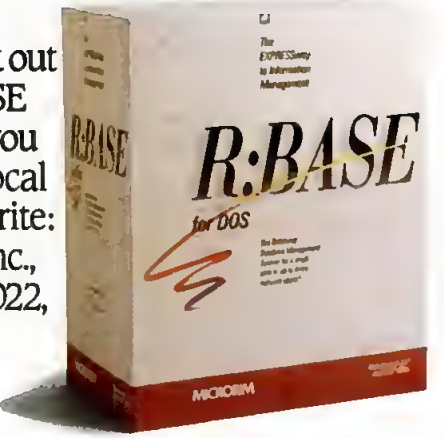

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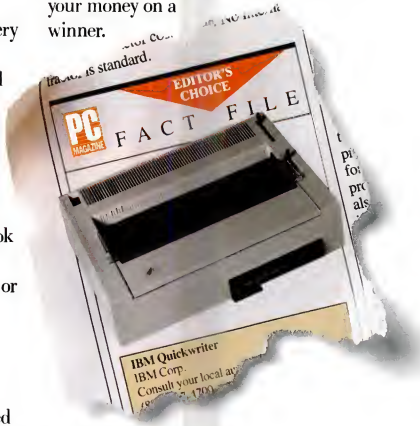

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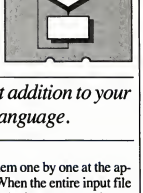

Routines for sorting, updating, and merging sequential files are an important addition to your Power Programming library. Here are versions both in C and in assembly language.

Having reviewed file system basics and terminology in the last several issues, we're now ready to explore file-management techniques in a practical way. Let's start with a brief consideration of sequential file management.

A sequential file is a collection of records that are accessed in the order of their occurrence in the file. Sequential files are most useful when:

- each record is so strongly dependent on the records surrounding it that it is meaningless out of context;
- there is a lot of data to store and you want to make the most efficient possible use of disk space; or
- the data is relatively stable, can be updated in a "batch" mode, and need not be accessed interactively and randomly.

In the days when magnetic tape drives were king, the efficient management of sequential files was developed into a fine art. If you look into computer science textbooks from the 1960s, you'll be amazed at the amount of space devoted to sorting, updating, and merging sequential files. Even techniques for reading sequential files backward (to avoid wasting time rewinding tapes) were a big topic. Donald Knuth's opus, *Sorting and Searching*, has whole chapters on this subject.

In our day, what with fast, cheap fixed disks, B-trees, relational databases, SQL, and the like, the topic of sequential file processing is no longer stylish; indeed, it has acquired a definitely musty aura. Nevertheless, the basic techniques should be stored in every programmer's mental attic for retrieval when needed. Besides, it gives me an excuse to provide you with some handy assembly language code to add to your Power Programming library.

SEQUENTIAL FILE BASICS Sequential file access in DOS and OS/2 is really very simple. When a file is opened or created, its file pointer is initially set to zero. If a program simply issues successive read or write requests without ever explicitly setting the file pointer position, then its access to the file is automatically sequential. After each transfer, the operating system updates the file pointer to point to the next byte to be read or written.

In the classic sequential file scenario, a program opens the input file, creates an output file, and copies records one at a time from the input to the output, making any necessary changes to the data on a record-by-record basis. If the program has new records to add to the file, it sorts them into the same order as those of the input file and then inserts them one by one at the appropriate points. When the entire input file has been processed, the program simply closes both files, renames the input file with the extension .BAK, and assigns the original name of the input file to the output file.

■ The simplest type of sequential file is made up of records that all have the same internal structure and are all exactly the same size.

The simplest type of sequential file is made up of records that all have the same internal structure and are all exactly the same size. Such a file design has one distinct advantage: if at some future time you need random access to the file, you can quickly build up a separate index that associates a key for each record with its record number—that is, its sequential position in the main file. You can then access any record directly by looking up its key value in the index, multiplying the record number by the record size, setting the file pointer, and issuing a read or write operation.

If a sequential file of fixed-length records is kept in sorted order, you can also find a record quickly using the divide-and-conquer strategy of a *binary search*. To start a binary search, you find the size of the file, calculate the number of records it contains, then inspect the middle record. If that record is a match, you're done. Otherwise, depending on whether the middle record was "before" or "after" the record you want, you next examine the middle record of the first or the second half of the file. You continue in this manner, successively bisecting the file until you either find the record you want or establish that it isn't there at all. This algorithm is surprisingly efficient: if a file contains N records, a maximum of $\log_2(N)+1$ and an average

■ POWER PROGRAMMING

of $\log_2(N) - 1$ comparisons are required to find a particular record.

Sequential files containing records with a fixed length and structure are relatively rare, however, because they forgo one of the main reasons for using a sequential file in the first place: the economical use of disk space. More commonly, sequential files contain variable-length records, in which the record's length and/or its contents are encoded in the record itself. Either the record:

- is terminated by a reserved delimiter;
- begins with a record-type code that implicitly specifies the record length;
- starts with a record-length code that implicitly specifies the record type (rarely used); or
- begins with explicit record-length and record-type codes.

The first of these encoding methods should be very familiar, since you use it every day. A text file is a prototypical sequential file made up of ordered, delimited, variable-length records. In text files, the end of each line (record) is indicated by a logical "new-line" character, which may actually consist of more than one physical character and may also vary from system to system. (In DOS systems, each line is terminated by a carriage return-line feed pair; in Unix, usually by a line feed alone; and in Apple ProDOS, by a carriage return alone.) We'll return to text-file processing shortly.

Unfortunately, delimited records make for slow and messy processing in two ways. First, the delimiter character(s) cannot (by definition) occur within the body of a record. Thus, when such characters occur as data rather than as delimiters, they must be encoded in some special way. Second, using delimited records means that the program must scan every byte of every record in order to find out where the next record starts!

The other encoding methods mentioned above are better suited to efficient sequential processing, especially when files contain a relatively small number of record types that must be searched and updated by many different programs. For example, when a record's type is encoded in a record "header," programs can quickly select the records in which they are interested and just as quickly bypass those they need not process. There's no need to scan each record for a delimiter to find the next record, since the length of each record type is known to the program. The contents of each record are not restricted in any way since there is no need to reserve delimiter characters.

Although the technique of explicitly encoding both a type and a length at the head of each record adds some bulk to a file, it is also by far the most powerful and flexible. Since record lengths are not "hard-wired" into programs, you can change them at any time without having to change those programs that do not process that particular record type. You can also add new record types at any time without changing existing programs, since they can simply use the length information in the record to skip over a record type they don't recognize.

We'll return to the topic of sequential files with multiple fixed record types in a future column. In the meantime, let's take a closer look at text-file processing in C and in assembly language.

```
/* NUMB1.C: Utility to number the lines in a file, using the C
   low-level file functions.
   Copyright (c) 1989 Ziff Communications Co.
   PC Magazine * Ray Duncan
*/

#include <stdio.h>
#include <string.h>
#include <fcntl.h>
#include <sys\types.h>
#include <sys\stat.h>
#include <io.h>

unsigned ifile;                 /* handle for input file */
unsigned ofile;                 /* handle for output file */

char fbuff[256];                /* file I/O buffer */
char iname[80];                 /* name of input file */
char oname[80];                 /* name of output file */

char newline[] = "\x0d\x0a";    /* MS-DOS logical new-line */

main(int argc, char *argv[])
{
    char *p, q[10];             /* scratch pointer, buffer */
    int line = 1, length;       /* line number, length */

    if(argc < 2)                /* make sure filename present */
    {
        fprintf(stderr,"\nnumb1: missing filename\n");
        exit(1);
    }

    strcpy(iname, argv[1]);     /* get input filename */
    strcpy(oname, argv[1]);     /* build output filename */
    if(! (p = strchr(oname, '.'))) /* point to extension */
        p = strchr(oname, '\0');
    strcpy(p, ".$$$");          /* temp. name for new file */

                                /* open input file */
    ifile = open(iname, O_RDONLY | O_BINARY);

                                /* create output file */
    ofile = open(oname, O_WRONLY|O_CREAT|O_TRUNC|O_BINARY, S_IWRITE);

    if((ifile == -1) || (ofile == -1))
    {
        fprintf(stderr,"\nnumb1: open or create error\n");
        exit(1);
    }

    while(length = rline())         /* read line from input file */
    {                               /* until end of file reached */
        sprintf(q,"%84d\t",line++); /* format line number */
        write(ofile,q,strlen(q));   /* write line number */
        write(ofile,fbuff,length);  /* write line text */
    }

    close(ifile);                   /* close input file */
    close(ofile);                   /* close output file */

    strcpy(p, ".bak");              /* build .BAK filename */
    unlink(oname);                  /* delete previous .BAK file */
    rename(iname, oname);           /* make original file .BAK */
    strcpy(p, ".$$$");              /* give new file same name */
    rename(oname, iname);           /* as original file */
}

/*  Read line from input file and return its length including
    the new-line delimiter character(s), leaving the line's
    text in 'fbuff'.  Returns 0 if end of file or new-line
    delimiter not found.
*/
int rline(void)
{
    char *p;                        /* pointer to delimiter */
    int i, j;                       /* scratch variables */

                                    /* read chunk of input file */
    i = read(ifile, fbuff, sizeof(fbuff)-1);
    if(i == 0) return(0);           /* exit if end of file */
    else fbuff[i] = 0;              /* otherwise store null byte */

    p = strstr(fbuff, newline);     /* search for delimiter */
    if(p == NULL) return(0);        /* none found, indicate EOF */
    j = p-fbuff+strlen(newline);    /* calculate line length */

                                    /* back up file pointer */
    lseek(ifile, (long) (j-i), SEEK_CUR);
    return(j);                      /* return length of line */
}
```

Figure 1: *NUMB1.C is a utility that numbers the lines of a text file using the C low-level file functions.*

TEXT-FILE PROCESSING IN C You've got at least two options if you want to process text files in C. You can do it the hard way, using the low-level file interface and scanning for the line delimiters within your program. This will require using the functions `open()`, `close()`, `read()`, and `write()` to fetch and store the file data, and a string function, such as `strchr()`, `strpbrk()`, or `strstr()`, to find the line terminators.

Or you can do it the easy way, taking

```
/*  NUMB2.C:    Utility to number the lines io a file,
                using the C "stream" file functiona.
    Copyright (c) 1989 Ziff Communicatioos Co.
    PC Magazine * Ray Duncan
*/

#include <stdio.h>
#include <string.h>

FILE *ifile;                        /* input file */
FILE *ofile;                        /* output flle */

char fbuff[256];                    /* file I/O buffer */
char iname[80];                     /* name of ioput file */
char oname[80];                     /* name of output file */

main(int argc, char *argv[])
{
    cher *p;                        /* scratcb pointer */
    iot lioe = 1;                   /* line number */

    if(srgc < 2)                    /* make aure filename present */
    {
        fprintf(atderr,"\nnumb2: missing filename\n");
        exit(1);
    }

    strcpy(iname, argv[1]);         /* get input filename */
    strcpy(oname, argv[1]);         /* build output filename */
    if(! (p = strchr(oname, '.')))  /* point to extenslon */
        p = strchr(oname, '\0');

    strcpy(p, ".$$$");              /* temp. oame for new file */

    ifile = fopen(iname, "r");      /* open input file */
    ofile = fopen(oname, "w");      /* create output file */

    if((ifile == NULL) || (ofile == NULL))
    {
        fprintf(atderr,"\nnumb2: open or create error\n");
        eait(1);
    }

    while(fgets(fbuff, 256, ifile) != NULL)
    {                               /* read until eod of file */
                                    /* write line number */
        fprintf(ofile, "%84d\t", line++);
        fputs(fbuff,ofile);         /* write line text */
    }

    fcloae(ifile);                  /* cloae input file */
    fcloae(ofile);                  /* cloae output file */

    strcpy(p, ".bak");              /* build .BAK filename */
    unlink(oname);                  /* delete previoua .BAK file */
    rename(iname, oname);           /* make original flle .BAK */
    strcpy(p, ".$$$");              /* glve new file aame name */
    rename(oname, iname);           /* as orlginal file */
}
```

Figure 2: *NUMB2.C numbers the lines of a text file using the C stream file functions.*

```
; RLINE.ASM --- read line from text file (MS-DOS veraion)
; Copyright (c) 1989 Ziff Communications Co.
; PC Magazine * Ray Duncan
;
; Call wlth:    DS:DX = buffer address
;               CX    = buffer alse
;               BX    = text file handle
;
;               Suffer should be larger than any line that
;               will ne encountered in the text flle.
;
; Returns:      AX    = length of line including new-line
;                       delimiter character(s), or 0 if
;                       end of file or no delimiter found.
;               DS:DX = text addreaa
;
;               Other regiatera preserved.

DGROUP  group   _DATA

_DATA   aegment word public 'DATA'

nl      db      0dh,0ah                 ; MS-DOS logical new-llne
nl_len  equ     $-nl

_DATA   ends

_TEXT   aegment word public 'CODE'

        eatrn   strnda:near             ; string search utility

        assume  cs:_TEXT

        public  rline
rline   proc    near

        pusb    ba                      ; save reglsters
        pusb    ca
        push    dx
        push    ai
        push    di
        push    es

                                        ; read cbunk from file...
        mov     ah,3fh                  ; Fxn 3FH = read
        int     21h                     ; transfer to MS-DOS
        jc      rllne8                  ; jump if read error
        or      ax,aa                   ; end of file?
        ja      rllne9                  ; yes, jump

        puah    aa                      ; aave actual data length
        push    bx                      ; aave input file handle
        push    dx                      ; save buffer base address
        push    ds

        push    ds                      ; set up for delimiter search
        pop     es                      ; XS:DI = atring to search
        puah    dx
        pop     di
        mov     dx,ax                   ; DX = striog length
        mov     si,DGROUP               ; DS:SI = delimiter address
        mov     da,ai
        mov     ai,offset DGROUP:nl
        mov     ba,nl_len               ; BX = delimiter length
        call    strndx                  ; aearch for delimiter

        pop     ds                      ; restore buffer base address
        pop     dx
        pop     ba                      ; restore input flle handle
        pop     aa                      ; restore orlglnal read lrngth
        jc      rline8                  ; jump if no delimiter found

        add     di,nl_len               ; calculate line length
        aub     di,da
        push    di                      ; and save it

        aub     aa,di                   ; calculate read excess
        neg     ax
        cwd
        mov     cx,ax                   ; CX:DX = amount to back
        xchg    dx,cx                   ; up file poioter
        mov     aa,4201h                ; Function 42B = seek
        int     21h                     ; transfer to MS-DOS

        pop     ax                      ; get back line length
        jmp     rline9                  ; and reture it to callsr

rline8: xor     aa,ax                   ; end of file or other srror,
                                        ; aet line length = 0

rline9: pop     es                      ; restore registera
        pop     di
        pop     si
        pop     dx
        pop     cx
        pop     ba
        ret                             ; return line length

rline   endp

_TEAT   ends
        eod
```

Figure 3: *RLINE.ASM is an assembly language DOS subroutine that reads a text file one line ot o time.*

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advantage of C's "stream" functions, specifically oriented toward processing text files. The basic function set, `fopen()`, `fclose()`, `fgets()`, and `fputs()`, will do most of the work, and you can use `fgetc()`, `fputc()`, `fscanf()`, and `fprintf()` when you have special conversion and formatting needs.

NUMB1.C (Figure 1) shows you the use of the low-level file functions with a text file, and the NUMB2.C (Figure 2) is a functionally identical program that uses the stream functions instead. Both accept a single filename on the command line and create a new version of that file with each line numbered. Both leave the original file as is and rename it with the extension .BAK. Note that NUMB2.C is shorter and simpler than NUMB1.C!

No C programmer in his right mind would ever use the low-level file functions to manipulate a normal ASCII text file in the style of NUMB1.C. But you may find NUMB1.C interesting because it uses an often-ignored capability of the DOS "seek" function to avoid the need for double buffering. The subroutine `rline()`, which is responsible for obtaining a line of text from the input file, first reads enough data to encompass the longest line that

```
;  TYPEFILE.ASM -- Simple demo of RFILE subroutine (MS-DOS version).
;                  Displays text file on standard output device.
;  Copyright (c) 1989 Ziff Communications Co.
;  PC Magazine * Ray Duncan
;  Requires: RFILE.ASM, STRINGS1.ASM, ARGV.ASM, ARGC.ASM.
;
;  Build:       MASM TYPEFILE;
;               MASM RFILE;
;               MASM STRINGS1;
;               MASM ARGC;
;               MASM ARGV;
;               LINK TYPEFILE+RFILE+STRINGS1+ARGC+ARGV;
;
;  Usage:       TYPEFILE filename.ext

cr      equ     0dh             ; ASCII carriage return
lf      equ     0ah             ; ASCII line feed
blank   equ     20h             ; ASCII space code

blksize equ     256             ; size of input file buffer

cmd     equ     80h             ; buffer for command tail

stdin   equ     0               ; standard input handle
stdout  equ     1               ; standard output handle
stderr  equ     2               ; standard error handle

DGROUP  group   _DATA,STACK

_TEXT   segment word public 'CODE'

        extrn   argc:near       ; external subroutines
        extrn   argv:near
        extrn   rline:near

        assume  cs:_TEXT,ds:DGROUP,es:NOTHING,ss:STACK

main    proc    far             ; entry point from MS-DOS

        mov     ax,DGROUP       ; make our data segment
        mov     ds,ax           ; addressable via DS
                                ; (leave ES = PSP segment)

                                ; check if filename present
        mov     bx,offset cmd   ; ES:BX = command tail
        call    argc            ; count command arguments
        cmp     ax,2            ; are there 2 arguments?
        je      main1           ; yes, proceed

                                ; missing filename, display
                                ; error message and exit
        mov     dx,offset msg2  ; DS:DX = message address
        mov     cx,msg2_len     ; CX = message length
        jmp     main5           ; go display it

main1:                          ; get address of filename
        mov     ax,1            ; AX = argument number
                                ; ES:BX still = command tail
        call    argv            ; returns ES:BX = address,
                                ; and AX = length

        mov     di,offset fname ; copy filename to buffer
        mov     cx,ax           ; CX = length

main2:  mov     al,es:[bx]      ; copy one byte
        mov     [di],al
        inc     bx              ; bump string pointers
        inc     di
        loop    main2           ; loop until string done

        mov     byte ptr [di],0 ; add terminal null byte

        push    ds              ; set ES = DGROUP too
        pop     es
        assume  es:DGROUP

                                ; now open the file...
        mov     ax,3d00h        ; Fxn 3DH = open file
                                ; mode 0 = read only
        mov     dx,offset fname ; DS:DX = filename
        int     21h             ; transfer to MS-DOS
        mov     fhandle,ax      ; save file handle
        jnc     main3           ; jump, open successful

                                ; file doesn't exist
        mov     dx,offset msg1  ; DS:DX = error message
        mov     cx,msg1_len     ; CX = message length
        jmp     main5           ; go display it

main3:                          ; read line from file
        mov     bx,fhandle      ; BX = file handle
        mov     cx,blksize      ; CX = buffer length
        mov     dx,offset fbuff ; DS:DX = buffer
        call    rline
        or      ax,ax           ; reached end of file?
        je      main4           ; yes, exit

                                ; otherwise display line
        mov     cx,ax           ; line length
        mov     bx,stdout       ; standard output handle
        mov     ah,40h          ; Function 40H = write
        int     21h             ; transfer to MS-DOS

        jmp     main3           ; get another line

main4:                          ; success exit point
        mov     bx,fhandle      ; BX = file handle
        mov     ah,3eh          ; Fxn 3EH = close
        int     21h             ; transfer to MS-DOS

        mov     ax,4c00h        ; Fxn 4CH = terminate,
                                ; return code = 0
        int     21h             ; transfer to MS-DOS

main5:                          ; common error exit
                                ; DS:DX = message address
                                ; CX = message length
        mov     bx,stderr       ; standard error handle
        mov     ah,40h          ; Fxn 40H = write
        int     21h             ; transfer to MS-DOS

        mov     ax,4c01h        ; Fxn 4CH = terminate,
                                ; return code = 1
        int     21h             ; transfer to MS-DOS

main    endp

_TEXT   ends

_DATA   segment word public 'DATA'

fname   db      64 dup (0)      ; buffer for input filespec

fhandle dw      0               ; input file handle

fbuff   db      blksize dup (?) ; data from input file

msg1    db      cr,lf
        db      'typefile: file not found'
        db      cr,lf
msg1_len equ    $-msg1

msg2    db      cr,lf
        db      'typefile: missing filename'
        db      cr,lf
msg2_len equ    $-msg2

_DATA   ends

STACK   segment para stack 'STACK'

        db      64 dup (?)

STACK   ends
        end     main
```

Figure 4: *TYPEFILE.ASM is a DOS program that demonstrates the RLINE.ASM subroutine shown in Figure 3.*

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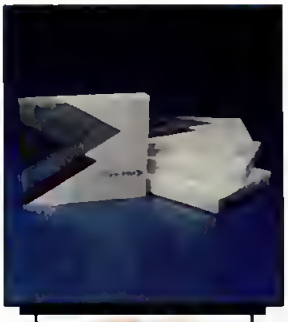

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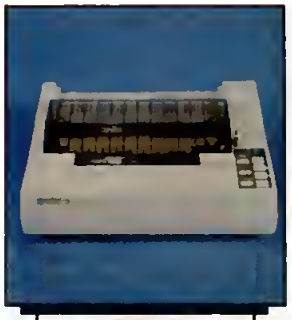

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might be written by a text editor. It then calls `strstr()` to search for the delimiter, calculates the actual line length, and "backs up" the file pointer so that the next read operation will begin exactly at the start of the subsequent line.

AN .ASM EQUIVALENT Using the C code in the utility NUMB1.C as a model, we can put together an assembly language subroutine that reads data from a file one line at a time. The DOS version of this routine, RLINE.ASM, is listed in Figure 3 and requires only a file handle, buffer address, and a length. If a complete line can be read, RLINE leaves the text in the buffer and returns its length; or, it returns zero to indicate that a new-line delimiter was not found or that the end of file was encountered.

The short DOS demonstration program TYPEFILE.ASM (Figure 4) can be linked with RLINE to illustrate its use. TYPEFILE expects the name of a text file on its command line, and it displays that file on the standard output device. If no filename is supplied, TYPEFILE issues an error message and exits.

In order to build TYPEFILE.EXE, you will need to gather together TYPEFILE.ASM, RLINE.ASM, STRINGS1.ASM (from our November 15, 1988, issue), and ARGC.ASM and ARGV.ASM (December 22, 1987), in your current directory. Then enter the commands

```
MASM TYPEFILE;
MASM RLINE;
MASM STRINGS1;
MASM ARGC;
MASM ARGV;
LINK TYPEFILE+RLINE+STRINGS1+ARGC+ARGV;
```

Finally, execute TYPEFILE.EXE with a command such as

```
TYPEFILE MYFILE.TXT
```

The OS/2 versions of TYPEFILE.ASM and RLINE.ASM are not printed here for reasons of space but are available for downloading on PC MagNet.

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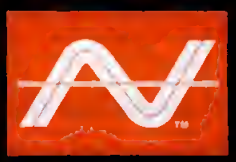

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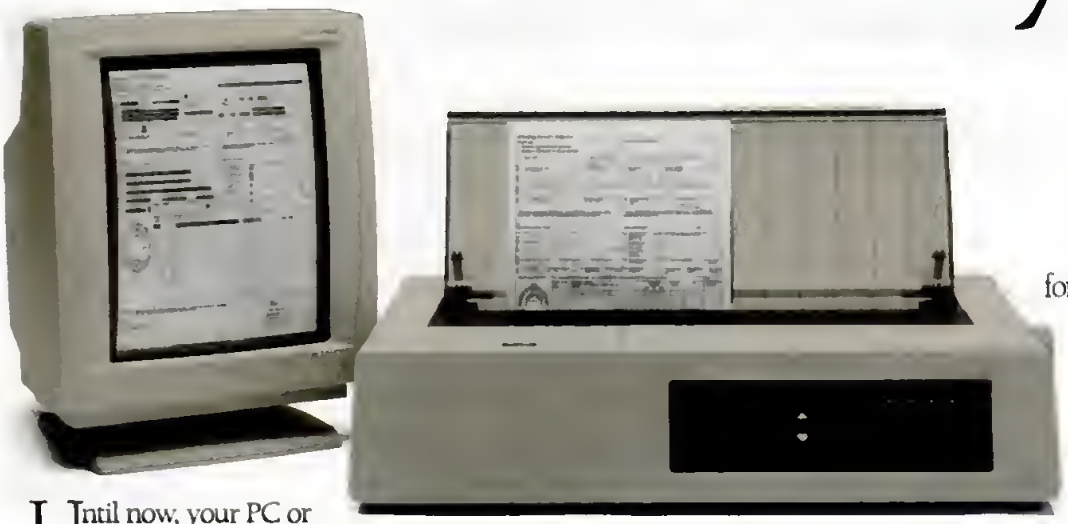

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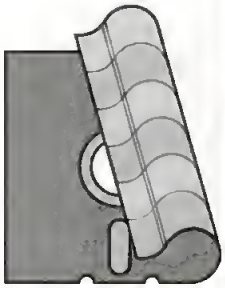

Applications for text and numeric lookup functions; ways to use a range address that has been stored as a label as the argument for the @SUM function.

Four ways to use the label form of a range address as the argument of a function

While creating a macro recently, I found I needed to use a range address that was stored as a label as the argument of an @SUM function. At first I tried to use the address of the cell that contained the range address as the argument of the @SUM function. Of course, this application did not work. In order to use this reference, I discovered that I had to use a calculated macro statement such as the one shown in Figure 1.

Cell B4, which is named RANGE, contains the label 'G1..G5—the label form of the range address whose values I wanted to sum. The first statement in this macro, {Recalc NEXT}, commands *Lotus 1-2-3* to recalculate the string formula

```
B2:  +"{Let RESULT,@SUM("&RANGE&")}~"
```

in the cell named NEXT—the next cell in the macro. When *1-2-3* recalulates this formula, it returns the string

```
"{Let RESULT,@SUM(G1..G5)}~"
```

which is a valid macro statement that tells *1-2-3* to enter the result of the function @SUM(G1..G5) into the cell named RESULT (B6). Since cells G1..G5 contain the values 1 through 5, this macro places the value 15 into RESULT.

If you wish, you can modify this technique in several ways. First, you can combine the {Recalc} and {Let} commands into a single calculated statement, as shown in Figure 2. Cell A1 of this macro contains the statement

```
B1:  +"{Recalc \s}{Let RESULT,
     @SUM("&RANGE&")}~"
```

No matter what entry is in RANGE, this formula always returns a string that begins with the command {Recalc \s}.

This command causes *1-2-3* to recalculate the first statement in the macro (which is the statement that instructs it to perform the recalculation!). This procedure updates the remainder of the statement, ensuring that *1-2-3* sums the correct range.

A second modification lets you use one {Let} statement to place another {Let} statement into the next cell of the macro, as shown in Figure 3. As you can see, cell B1 contains the statement

```
B1:  '{Let NEXT,+"{Let RESULT,
     @SUM("&RANGE&")}~"}~
```

Assuming that RANGE contains the label 'G1..G5, *1-2-3* will place the label

```
'{Let RESULT,@SUM(G1..G5)}~
```

into NEXT (cell B2) when it executes the

	A	B	C	D	E	F	G	H
1	\s	{Recalc NEXT}					1	
2	NEXT	{Let RESULT,@SUM(G1..G5)}~					2	
3							3	
4	RANGE	G1..G5					4	
5							5	
6	RESULT							
7								

Figure 1: *This macro uses a calculated macro statement to use the range address stored in cell B4.*

	A	B	C	D	E	F	G	H
1	\s	{Recalc \s}{Let RESULT,@SUM(G1..G4)}~					1	
2							2	
3	RANGE	G1..G4					3	
4							4	
5	RESULT						5	
6								

Figure 2: *This macro embeds the {Recalc} command within the calculated macro statement.*

	A	B	C	D	E	F	G	H
1	\s	{Let NEXT,+"{Let RESULT,@SUM("&RANGE&")}~"}~					1	
2	NEXT						2	
3							3	
4	RANGE	G1..G5					4	
5							5	
6	RESULT							
7								

Figure 3: *This macro uses one {Let} statement to place another {Let} statement into another cell.*

■ SPREADSHEET CLINIC

statement in cell B1. This statement commands *1-2-3* to place the result of the function @SUM(G1..G5) into the cell named RESULT.—*Glenn Patsch; South Euclid, Ohio*

The first technique mentioned in this letter is the one preferred by most *1-2-3* users. However, the modifications are viable alternatives. The first variation requires one less line and one less named range than the first technique. The second variation is useful when one of the ranges involved in the calculation is not named when you create the macro.

However, the @@ function provides an even simpler way to use a range address that is stored as a label as the argument of a function. When an @@ function references a cell that contains the label form of the address of a range, it returns a reference to that range—exactly what you need within a function.

In this case, the first thing you would do would be to replace the statement in cell B1 of the macro shown in Figure 2 with the statement

```
B1:  '{Let RESULT,@SUM(@@(RANGE))}~
```

as shown in Figure 4. Since RANGE contains the label 'G1..G5, the function @@(RANGE) returns a reference to that range.

Consequently, the second argument of the {Let} command is equivalent to @SUM(G1..G5). And consequently, *1-2-3* places the result of that function—the value 15—into RESULT.

	A	B	C	D	E	F	G	H
1	\s	{Let RESULT,@SUM(@@(RANGE))}~						1
2								2
3	RANGE	G1..G5						3
4								4
5	RESULT							5
6								

Figure 4: *The @@ function is the simplest way of using a range address that is stored as a label as the argument of a function.*

	A	B	C	D	E	F	G
1		1984	1985	1986	1987	1988	
2	Hammers	$7,989	$6,591	$6,218	$3,922	$5,988	
3	Pliers	$9,785	$9,545	$4,606	$1,955	$4,982	
4	Wrenches	$8,955	$8,904	$9,854	$2,843	$7,110	
5	Screwdrivers	$7,461	$9,386	$2,434	$5,920	$7,146	
6	Drills	$5,983	$7,282	$6,124	$4,685	$7,682	
7							
8	Product:	Wrenches					
9	Year:	1986					
10							
11	Result:	$9,854					
12							

Figure 5: *You can look up information on the basis of two variables by using a zero-offset text lookup function as the offset argument of a lookup function with the opposite orientation.*

	A	B	C	D	E	F
1				1	177	
2	INPUT:	10		3	84	
3				5	911	
4				7	276	
5	RESULT:	ERR		9	250	
6				11	600	
7				13	460	
8				15	962	
9				17	291	
10				19	972	
11						

Figure 6: *Cell B5 of this worksheet contains the function* @IF(@VLOOKUP(B2,D1..E10,0)=B2,@VLOOKUP(B2,D1..E10,1),@ERR).

Two applications for zero-offset lookup functions

I often need to look up information in a *Lotus 1-2-3* table based on two variables. For example, I may need to look up the value of wrenches sold in 1986 from a table such as the one shown in Figure 5. To do this, I would enter the function

```
@HLOOKUP(B9,A1..F6,@VLOOKUP(B8,A1..F6,0))
```

into cell B11. This function returns the value $9,854 from cell D4—the cell at the intersection of the 1986 column and the Wrenches row.

1-2-3's treatment of zero-offset text functions, such as @VLOOKUP and @HLOOKUP, is the key to this technique. Unlike zero-offset numeric lookup functions, text lookup functions with an offset argument of 0 return the offset of the matching entry relative to the first cell of the key column or row. For example, since cell A4 of the worksheet shown in Figure 5 contains the label 'Wrenches, the function

```
@VLOOKUP(B8,A1..F6,0)
```

returns the value 3—the offset of cell A4 from the topmost row of the table. This value serves as the offset argument of the @HLOOKUP function. Specifically, the function in cell B11 becomes the equivalent of

```
@HLOOKUP(B9,A1..F6,3)
```

which then returns the value $9,854 from cell D4.

In order for this technique to work, at least one of the axes of the table must contain text entries. If only the left axis of the table contains labels (as it does in Figure 5), you must use a zero-offset @VLOOKUP function as the offset argument of an @HLOOKUP function. If only the top axis of the table contains labels, you must use a zero-offset @HLOOKUP function as the offset argument of an @VLOOKUP function. If both axes contain label entries, you can use either a zero-offset @HLOOKUP function as the offset argument of an @VLOOKUP function, or a zero-offset @VLOOKUP function as the offset argument of an @HLOOKUP function.—*Kevin H. Carracher; Cuyahoga Falls, Ohio*

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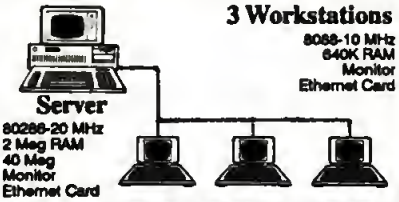

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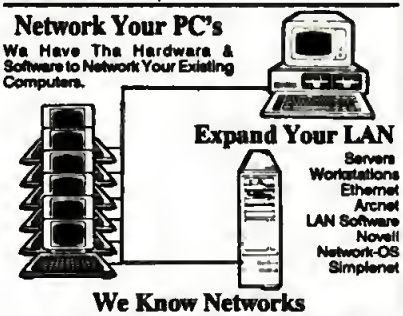

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■ SPREADSHEET CLINIC

The action of zero-offset text lookup functions was programmed specifically to make possible the technique described here.

As you might guess, there's also a use for zero-offset numeric lookup functions. Unlike text lookups, numeric lookups do not work on an exact-matching basis. Let's suppose that the key column of a numeric @VLOOKUP function does not contain an exact match for the key value. *1-2-3* will return a result from the row immediately above the one that contains the first value that exceeds the key value. Similarly, if the key row of a numeric @HLOOKUP function does not contain an exact match for the key value, *1-2-3* will return a result from the column immediately to the left of the one that contains the first value that exceeds the key value.

To perform an exact-matching numeric lookup, you must use a combination of two @VLOOKUP functions within an @IF statement. Figure 6 is a good example. To look up the value in cell B2 of this worksheet from the table in cells D1..E10 on an exact-matching basis, you would use the function

```
B5:  @IF(@VLOOKUP(B2,D1..E10,0)=B2,
       @VLOOKUP(B2,D1..E10,1),@ERR)
```

Unlike the simple function

```
@VLOOKUP(B2,D1..E10,1)
```

this function returns an entry from column E only if column D contains the key value. Otherwise, *1-2-3* will return the value ERR. This action mimics the way *1-2-3* behaves when the key entry is a label.

It is the conditional test of the @IF function

```
@VLOOKUP(B2,D1..E10,0)=B2
```

that determines whether or not there is a match for the key value within the key column. The @VLOOKUP function on the left side of this test searches down the key column for the first entry that exceeds the value in cell B2. *1-2-3* then backs up one cell and, because the offset of the function is 0, returns the value from that cell.

Setting this function equal to B2 makes it a conditional test. If the key column contains an exact match for the key value, the function will return that value, making the conditional test true. If this happens, *1-2-3* will evaluate the true argument

```
@VLOOKUP(B2,D1..E20,1)
```

which returns the entry from column E that corresponds to the exact match of the key value in column D.

If the key column does not contain an exact match for the key value, however, the @VLOOKUP function in the conditional test will return a value that is less than the key. When this happens, the conditional test of the @VLOOKUP function will be false. Consequently, *1-2-3* will evaluate the false argument of the @IF function, @ERR. This function returns the value result ERR—the same result that a "text" @VLOOKUP function returns when it cannot find its key label.

In this case, *1-2-3* looks for the value 10 among the cells of the key column. Since none of the cells of the key column contain this value, but cell D11 contains the value 11, the @VLOOKUP function in the conditional test returns the value 9 from cell D5. Because this result is not equal to the key value (10), the conditional test is false and *1-2-3* returns the result ERR. The simple function

```
@VLOOKUP(B2,D1..E10,1)
```

would return the value 250 from cell E10.

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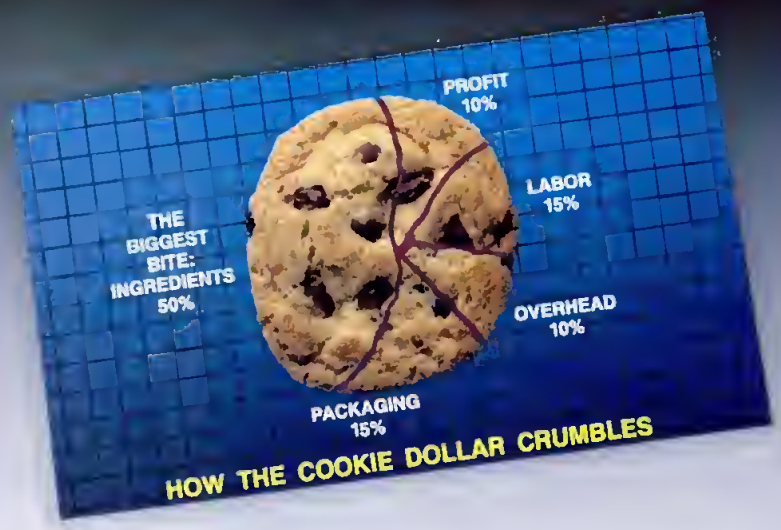

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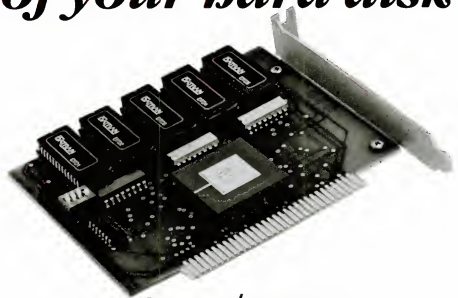

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USER-TO-USER

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A batch program that carefully moves files around your disks

A command to move a file from one place to another is something that DOS is missing. Of course, you can do this by copying a file and then deleting its original. However, I wanted to accomplish this in a single command. And I wanted to do it safely. MOVE.BAT, shown in Figure 1, does just this. The general syntax is

```
MOVE [source_directory] filename
 destination_directory,
```

The brackets in the syntax indicate an optional parameter.

Some examples of how to use MOVE.BAT are

```
MOVE resp.ect songs
```

This moves the RESP.ECT file from the current directory to the SONGS directory.

```
MOVE resp.ect ..
```

This moves the RESP.ECT file from the current directory to the parent directory.

```
MOVE resp.ect A:
```

RESP.ECT moves to the root directory of the diskette in drive A:. Do not use A:\.

```
MOVE resp.ect \songs\aretha
```

RESP.ECT moves to the directory named SONGS\ARETHA on the default drive.

```
MOVE \songs\aretha resp.ect A:\songs\aretha
```

This moves the RESP.ECT file from the directory SONGS\ARETHA on the default drive to the directory SONGS\ARETHA on drive A:.

```
MOVE \songs\aretha resp.ect .
```

RESP.ECT moves from the directory SONGS\ARETHA on the default drive to the current directory, represented by ".".

Suppose that the default directory is not the root directory. In order to move a file from the root directory of the default drive, you must specify the default drive name as follows (assuming C: as the default drive):

```
MOVE C: resp.ect .
```

This moves RESP.ECT from the root directory of drive C: to the current directory. Do not use "MOVE\RESP.ECT.".

I anticipated these error conditions:

■ "Source file does not exist"—Nothing is done.

■ "Old version could not be deleted"—A file with the same name exists in the destination directory but could not be deleted before COPY. Nothing is done.

■ "Copy unsuccessful"—The old version in the destination directory, if it existed, has been deleted. The original file you

```
ECHO OFF
IF %1'==' GOTO syntax_error
IF %2'==' GOTO syntax_error
SET movepath=%3
IF %3'==' GOTO begin
SET movepath=%1\
SHIFT
GOTO begin
:syntax_error
ECHO Syntax is: MOVE [source_directory] filename destination_directory
GOTO end
:begin
IF EXIST %movepath%%1 GOTO L1
ECHO Error. Source file does not exist!
GOTO end
:L1
IF EXIST %2\%1 DEL %2\%1
IF NOT EXIST %2\%1 GOTO L2
ECHO Error. Old version could not be deleted!
GOTO end
:L2
COPY %movepath%%1 %2\%1
IF EXIST %2\%1 GOTO L3
ECHO Error. Copy unsuccessful!
GOTO end
:L3
DEL %movepath%%1
IF NOT EXIST %movepath%%1 GOTO L4
ECHO Error. Could not delete the original!
GOTO end
:L4
ECHO successful Move.
:end
```

Figure 1: *MOVE.BAT copies a file to a new location and deletes the original.*

■ USER-TO-USER

want to move is still intact.

■ "Could not delete the original"—COPY has been successful, but the original file could not be deleted.—*Mohammad Dadashzadeh; Novi, Michigan*

This batch file is a bit unusual in that its *first* parameter is optional. This is done by storing the first parameter in an environment variable and using SHIFT to move the second and third parameters into the first and second places. If there are only two parameters, the environment variable gets a null string. After the parameter-checking lines, %1 refers to the filename and %2 to the destination directory.

There are utilities that move files by using the DOS internal RENAME function to change their full pathnames. However, these utilities can't move from one disk to another, and they fail if a file of the same name already exists in the destination directory. MOVE.BAT will be handy if you often need to move files to another location and eliminate the originals.

Amending INSTALL.BAT—a quick way to add text to a file

I have a couple of comments on John W. Ross's otherwise excellent INSTALL.BAT (User-to-User, *PC Magazine*, October 11, 1988).

There is a typographical error in Figure 3: IF EXISTS should read IF EXIST. Using the batch file as printed will generate a syntax error and proceed to overwrite an existing AUTOEXEC.BAT file instead of appending commands to it as intended.

Additionally, the PATH= command was intended to append a new subdirectory to any existing path statement in the AUTOEXEC.BAT file. However, this command only updates the current path's *environment variable* and leaves the path *statement* alone. The usefulness of this command is questionable since when the computer is booted with the modified (or newly created) AUTOEXEC.BAT file, the path's environment variable will simply revert to its original contents.—*Steve Offner; Carlsbad, New Mexico*

Indeed there is a typographical error in the figure. As logical as it might sound, "IF EXISTS" is wrong. The second point is also valid—the path will include the new directory only until the computer is rebooted. However, there's a simple solution. Just add the following line to the end of INSTALL.BAT:

```
ECHO PATH=%%PATH%%;D:\NEWDIR >> AUTOEXEC.BAT
```

This appends a line to the end of AUTOEXEC.BAT that's identical to the final line of the previous INSTALL.BAT. The double percent signs (%%) are echoed as single ones. As a result, every time AUTOEXEC runs, it will append the new directory to any existing path—just what we want to happen.

Turn old business cards into low-tech memory aids

When I get a new program that uses the ten function keys (located on the left side of my keyboard where they're supposed to be!), I grab one of the business cards that seem to stack up around my office and make a quick function-key layout on the back to act as a memory jog. Applying some double-sided tape to the back of the card lets me stick it right next to the function keys, or I can just prop it up on the keyboard above the function keys.

Try it—a business card is just the right size for making a quick template to help speed up your work.—*Gordon Castro; Victoria, Texas*

Of course, many programs already use cutout key templates to define their function keys. But templates get lost, and not all programs include them. Record the contents of the business card in your business contacts database and then recycle it for greater productivity.

Formatting a floppy will remove all the files, but SCRUBbing it is faster

I needed a quick way to prepare a used floppy disk for reuse. Since my disks often have subdirectories and volume labels, deleting everything involved several steps. I found that the much-maligned RECOVER command did the job very well. SCRUB.BAT in Figure 2 shows this technique.

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RECOVER.COM deletes the volume label, removes the subdirectory structure, and renames all files to FILE0001, FILE0002, and so forth. The batch file takes care of the rest, including making sure that only your *floppy* disks are "scrubbed."—*Frank Murphy; Pebble Beach, California*

At last a use for the dreaded RECOVER command. Normally, you only use RECOVER as a last resort after having already written off the data as lost. If you expect nothing, any tidbit restored by RECOVER is valuable. RECOVER with just a drive letter as a parameter removes the directory structure and puts all the recovered files in the root directory of the disk. Files and subdirectories alike get assigned names in the form FILE????.REC.

SCRUB.BAT makes this behavior useful. Getting all the files into the root directory is handy if you're deleting them. SCRUBbing a disk is faster than formatting it.

RECOVER, just like FORMAT, is an external DOS command, so make sure RECOVER.COM is on your path.

SCRUB.BAT will fail if there are more than 112 files on the disk to be scrubbed. All you have to do is SCRUB it again.

```
:--- SCRUB.BAT
IF "%1"=="" GOTO SYNTAX
FOR %%d IN (A: B: a: b:) DO IF %1==%%d GOTO OK
ECHO SCRUB can only be used on a Floppy Disk
GOTO SYNTAX
:OK
ECHO | RECOVER %1 > NUL
DEL %1FILE*.* > NUL
GOTO END
:SYNTAX
ECHO Syntax ...  "SCRUB d:"
:END
```

Figure 2: *SCRUB.BAT wipes files off a floppy disk faster than formatting.*

A batch file to execute DOS commands for all files that match a template

How many times have you wanted to execute a DOS command for multiple files but found you had to enter all the filenames in-

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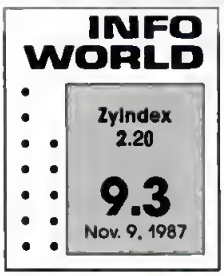

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■ USER-TO-USER

```
@ECHO OFF
CLS
IF "%2" == "" GOTO error
ECHO Executing the command %1 for files matching %2
FOR %%X IN (%2) DO COMMAND/C %1 %%X
GOTO end
:error
ECHO SYNTAX: MULTI command filename.ext
ECHO   e.g. "MULTI TYPE *.*" or "MULTI BROWSE *.TXT"
:end
```

Figure 3: *MULTI.BAT lets you give wildcard file specifications to commands.*

dividually? For example, DOS can't process the command `TYPE *.TXT` to list a group of related files to the screen or printer. MULTI.BAT in Figure 3 represents one solution to this common problem.

The real utility and magic of this batch file come from the simplicity and power of the FOR loop construct. A literal translation of the FOR loop used in this particular batch file might be: "For each file matching the second parameter, execute the command specified by the first parameter upon the matching file." Note that the COMMAND/C feature allows you to specify another batch file as the command to be executed. COMMAND/C will load another copy of the DOS command processor and release it when the command terminates. Hence, MULTI.BAT will work with any of your .COM, .EXE, or .BAT files.

Note that the character @ turns off local screen echo of the ECHO OFF command in DOS 3.3. The @ character should be removed if you do not use DOS 3.3. Also note that the batch file does not pause between each iteration of the FOR loop. If you want this to happen, just MULTI-execute another batch file that includes the appropriate PAUSE command.—*James C. Cummiskey; Albany, Georgia*

MULTI.BAT will work with any command that takes a file for its first *and only* command-line parameter. If the command needs other command-line switches, MULTI.BAT won't work. You *can* modify MULTI to handle up to seven switches. Just add the replaceable parameters %3 through %9 after the %%X. For example:

```
... COMMAND/C %1 %%X %3 %4 %5 %6 %7 %8 %9
```

Now, MULTI can handle commands that take command-line switches, such as

```
MULTI MYPROG *.* /X:10 /Y:20
```

MULTI.BAT's disadvantage is that it has to reload the secondary COMMAND.COM for every file. If you're willing to forgo using MULTI on batch files, you can eliminate the COMMAND/C from the FOR loop and save the time of reloading COMMAND.COM. To see the speed difference, try `MULTI ECHO *.*` with and without the COMMAND/C.

■ EDLIN creates a temporary file to hold your editing changes with the .$$$ extension. When you save the new file, EDLIN renames it with a .BAK extension.

Certain filenames are forbidden in EDLIN

I have recently discovered a bug in the DOS program EDLIN. I think it has persisted since DOS 2.0. It may also have been in earlier releases, but I have not tested these versions.

I recently generated a text list of commands to be displayed with TYPE during the execution of a batch file. I elected to name the file $INSTR$.$$$, thinking it unlikely that anyone else would happen to use the same name.

I used the statement `COPY CON $INSTR$.$$$` to create the file, and EDLIN to make a few changes. But after I edited the file, it disappeared. I discovered that EDLIN doesn't like three dollar signs in the extension. Two are OK, but three cause EDLIN to wipe out the file and in some cases take the .BAK file too.—*Peter Nolan; Marrickville, New South Wales, Australia*

This isn't actually a bug; EDLIN is working the way it was meant to. While you're editing a file with EDLIN, it creates a temporary file to hold your changes with the extension .$$$. When you save the changed file, EDLIN renames the original file with a .BAK extension and then renames the temporary file to the original filename. If the original file has a $$$ extension, however, EDLIN will wipe it out. Clearly, you should never use EDLIN on such a file without first renaming it to a safer extension.

Productivity Tip

Sometimes you want a batch file to execute invisibly. ECHO OFF hides some screen output, and redirecting the output of commands to the NUL device hides more. But it's a pain to add "> NUL" to every command, and messages to the ERR device will show through. To hide *all* output, use the line CTTY NUL before the lines to be hidden and CTTY CON after. Don't forget the CTTY CON–omit it and you'll have to reboot.

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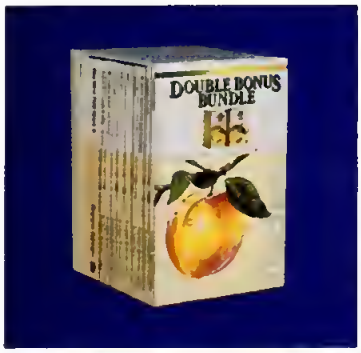

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CIRCLE 358 ON READER SERVICE CARD

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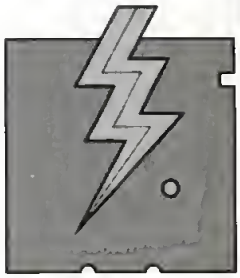

POWER USER

Controlling the cost of replacing daisy wheel printer ribbons; making SideKick's cursor easier to see on a laptop; creating a personal menu with WordPerfect 5.0.

Here's how to use *WordPerfect* 5.0's advanced macro commands to create your own personalized menus

The macro menu shown in Figure 1 is a template that you must customize for your own use. The macro is structured, both to minimize the work involved in customization and to allow users with only a limited knowledge of the *WordPerfect*, Version 5.0, macro language to use it.

The macro shown below is divided into three sections:

■ The menu section. This section lists the available macros and provides a short description of each. It requires only a single keystroke from the user. If the key struck is F1, the macro ends without doing anything; otherwise, it places the keystroke in Variable 1.

■ The {CASE CALL} section. This is the traffic director. Based on the value in Variable 1, it branches to the appropriate {LABEL}. Note that for those items whose designator is a letter (for example, macroA, macroB, and macroC), the {CASE CALL} recognizes both upper- and lowercase entries.

■ The {LABEL} section, which contains the various {LABEL}s. Each {LABEL} is a subroutine that runs a named macro.

```
{ON CANCEL}{GO}end~~
{DISPLAY OFF}
{PROMPT}{Del to EOP}
·····(^])Macro·Help·and·Executioo·Menu(^\){Enter}
{Enter}
(^])1(^\)·macro1·:·deacriptioo·····
(^])2(^\)·macro2·:·deacription·····{Enter}
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(^])4(^\)·macro4·:·deacription·····{Enter}
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(^])B(^\)·macroB·:·deacription·····
(^])C(^\)·macroC·:·deacription·····{Enter}


~


{CHAR}1~Enter·Your·Choice·Or·Preaa·F1·to·Cancel:

{CASE CALL}{VAR 1}~
1~macro1~
2~macro2~
3~macro3~
4~macro4~
5~macro5~
6~macro6~
7~macro7~
8~macro8~
9~macro9~
A~macroA~a~macroA~
B~macroB~b~macroB~
C~macroC~c~macroC~
~
{RETURN}
{LABEL}macro1~
    {Macro}macro1{Enter}
    {RETURN}
{LABEL}macro2~
    {Macro}macro2{Eoter}
    {RETURN}
{LABEL}macro3~
    {Macro}macro3{Enter}
    {RETURN}
{LABEL}macro4~
    {PROMPT}{Del to EOP}~
    {DISPLAY ON}
    {Macro}macro4{Enter}
    {RETURN}
{LABEL}macro5~
    {Macro}macro5{Enter}
    {RETURN}
{LABEL}macro6~
    {Macro}macro6{Enter}
    {RETURN}
{LABEL}macro7~
    {Macro}macro7{Enter}
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{LABEL}macro9~
    {Macro}macro9{Enter}
    {RETURN}
{LABEL}macroA~
    {Macro}macroA{Enter}
    {RETURN}
{LABEL}macroB~
    {Macro}macroB{Enter}
    {RETURN}
{LABEL}macroC~
    {Macro}macroC{Enter}
    {RETURN}
{LABEL}end~
    {RETURN}
```

Figure 1: *Use the macro editor to enter the menu macro listed here. The macro allows you to create customized menus in* WordPerfect *5.0.*

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■ POWER USER

CUSTOMIZING For each macro you install you need to modify all three areas.

■ Modifying the menu area is fairly simple. Just replace the dummy items (that is, macro1, macro2, and so on) with the names of your own macros and add a short description after the colon. You may need to adjust the spacing for macro names that are longer or shorter than six characters. To add more macros, just follow the same format. The combinations shown as {^]} and {^\} turn bold on and off, respectively. To produce them, hold down the Ctrl key and press the] or \ key.

■ Modifying the {CASE CALL} area is also easy. For the sake of clarity, I use the name of the macro as the {LABEL}. For example, to install a macro called ENV as choice A, I would change macroA to ENV in both places it appears in the {CASE CALL} statement. When adding new alphabetic choices be sure to allow for both upper- and lowercase values.

■ The {LABEL} section is the one most likely to cause difficulties. In most cases you simply need to put the name of the macro between the {MACRO} and {RETURN} commands. It gets trickier, however, when your macro invokes a *WordPerfect* menu, a file list, or anything where you will need to respond to a regular *WordPerfect* screen. In that case you also need to clear the screen and turn on the display. The macro4 label provides an example of this procedure.

OTHER POTENTIAL PROBLEMS The macro editor has some size limitations that will probably prevent you from having more than about 30 macros on the menu. The largest macro file I have been able to create with the editor has been 3,709 bytes. The symptom of this problem is that the macro editor will stop responding to all keystrokes except the delete key and the backspace key. If you delete a character, you can then add a character. Note that this is a limitation of the macro editor and not of macros in general.

If the size limitation is cramping your style, it is possible for you to reorganize the menu into two macros: one that will draw the menu and chain to the second, which does the case call and the actual macro execution.—*Richard Bednarski; Miraloma, California*

This menu macro is a complex piece of programming. You can download it from PC MagNet rather than type it in. In either case, you'll customize the result to your own menu choices.

If you don't have a modem, you can type it yourself entirely within the macro editor. You can't create a new macro in the editor, so first create a blank macro and then edit that. Hit Ctrl-F10 and start defining MACMEN, then hit Ctrl-F10 again. MACMEN now exists as an empty macro. Hit Ctrl-F10 again and give the name MACMEN. This time you're given the choice to Replace it or Edit it; select choice 2, Edit. In the editor, select choice 2, Edit Action. Now you're ready to go.

Follow Figure 1 carefully and enter the macro according to these rules. Anything in all capital letters surrounded by braces (for example, {LABEL}) is an advanced macro command. To insert one of these items, hit Ctrl-PgUp. The macro command menu will appear. Type the first letter of the command you want, then move the highlight bar to the exact item. Hit Enter to insert the command. To insert a {VAR n} code, press Ctrl-V followed by Alt-n, making sure to use the top row number keys. To insert {^]} and {^\}, press Ctrl along with the] or \ keys.

Standard *WordPerfect* commands appear in braces, but are not shown in all capital letters (for example, {Del to EOP}). In most cases you can simply press the corresponding key. If the key is one that's used within the macro editor, press Ctrl-V first. For example, to insert an {Enter} code, you press Ctrl-V followed by the Enter key.

Anything else in the macro is text: just type it in. Spaces show up as a midline dot character ("z"). Be careful to type in the tildes (~) correctly: they signify the end of certain macro commands.

Once you have the macro typed in completely, hit F7 twice to save it and exit the macro editor. Make a backup copy of MACMEN.WPM before attempting to customize it.—*Neil J. Rubenking*

Productivity Tip

Relay Communications maintains a bulletin board with all current patches for *Relay Gold* and *Silver*. Registered users should

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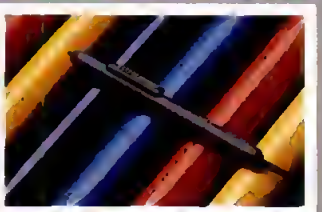

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Make *SideKick*'s cursor easier to see when working on a laptop

People who use *SideKick* on portables with LCD screens often find the blinking underline cursor difficult to see. Here's a patch that changes the cursor into a more visible blinking block.

Start by making a copy of the SK.COM file (call it SKBLOCK.COM) and bring it up in DEBUG with the command

```
DEBUG skblock.com
```

At the DEBUG prompt, type

```
S 0000 FFFF B9 07 06 <enter>
```

DEBUG will return one or more sets of numbers, which will take the form *xxxx:YYYY*. One of the *YYYY* numbers is the one you want. In my version of *SideKick* (1.56B), DEBUG returned two sets of numbers. The proper one was the second (133D). If you have a different version of the program, you'll have to experiment, trying each set until you find the one that works.

Starting with any of the numbers, type

```
E YYYY<enter>
<space><space>00<enter>
W<enter>
Q<enter>
```

The last command returns you to DOS. Load your modified copy of *SideKick* to see if the patch worked. If not, erase the modified SKBLOCK.COM, make another copy from your original, and try again with another set of the numbers returned by the Search command.—*Linc Kesler; Corvallis, Oregon*

This patch works, but after trying the modified file on a Toshiba 1100 Plus, I'm not entirely convinced that the more visible cursor is an advantage. Certainly, the default *SideKick* cursor can easily get lost on an LCD screen, but I find the large blinking block cursor distracting.

However, when you edit SKBLOCK.COM in order to include the line

```
<space><space>00<enter>
```

in the patch, you can replace the 00 with any number lower than 06 and still wind up with a larger cursor. Specifically, the lower the number, the larger the cursor. I found the setting of 05 to be the best compromise.—*M. David Stone*

An inexpensive substitute for costly daisy wheel printer film ribbons

Readers who are still using daisy wheel printers should consider the benefits of carbon paper for cutting costs and stretching ribbon supplies. If you remove the costly carbon-film ribbon from your letter quality printer and place ordinary carbon paper so that the daisy wheel hits it directly, you'll find that the print quality is almost as good as using a carbon-film ribbon.

I have found this technique highly useful for printing test runs of new merge documents when checking formatting. And it can be a lifesaver if you run out of ribbon in the middle of a print run.—*Robert H. Geeslin; Tulsa, Oklahoma*

I must confess that this tip sounded absolutely off-the-wall until I tried it on my aging Diablo 630. Sure enough, the print quality was sharp and clear—more than good enough for test runs and even in-house drafts. Rather than bother with separate sheets of carbon paper, you might want to use manifold paper—the kind that comes in sets, with the carbon already attached to the paper.—*M. David Stone*

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Btrieve's vital statistics are equally impressive. Files may have up to 24 indexes, fixed record length to 4090 characters, variable length to 64K, indexes to 255 characters, files of 4 billion bytes. Network support includes Novell, 3-COM, IBM PC NET, Software Link's Multilink and many others.

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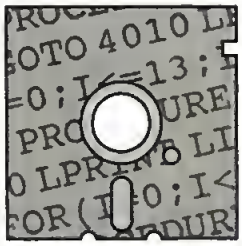

A BASIC routine that automatically keeps track of program modifications; how to use the keyboard LEDs as a binary display; a program that lets you multitask in BASIC.

Using idle time for multitasking in BASIC

I have seen many ways to create a delay routine in BASIC; however, all of them sit in an empty loop, precluding the program from doing anything else. The subprogram shown in the listing DELAY.BAS (Figure 1) not only provides a delay but will also return the number of seconds remaining. This even allows you to perform different tasks depending on how much time is left.
—Everett Sumner; Redford, Michigan

This is a good technique, and it's not limited to time delays. For example, a menu program could be written to return not only the item selected but also to indicate whether a choice was made at all. Then, if the user still hasn't made a selection, the program could go off and do something else for a while. In the example below, it is assumed that the menu subprogram will examine INKEY$ and return either the choice number or zero if INKEY$ is null:

```
DO
   'do something here
   CALL MENU(Choice)
LOOP UNTIL Choice
```

I have also found this technique useful when sorting very large database files. Most people wouldn't mind waiting a little longer if they could be doing something else in the meantime. In this case, the key is to have the sort program return periodically as it progresses. You will also need to manipulate an extra variable, perhaps

```
Delay.start! = TIMER              'the start of the delay
Duration! = 1.5                   'we want to wait 1.5 seconds
CLS
DO
   'do any desired tasks
   CALL Delay(Delay.start!, Duration!, Time.left!)
LOOP WHILE Time.left! > 0


SUB Delay (Start.time!, Dur!, Secs.left!) STATIC
   IF TIMER >= Start.time! THEN       'same day as we started
      Secs.left! = Start.time! + Dur! - TIMER
   ELSE                               'we have passed midnight
      Secs.left! = Start.time! + Dur! - TIMER - 86400
   END IF
END SUB
```

Figure 1: *A BASIC delay subprogram that also returns the amount of time remaining.*

```
DEFINT A-Z
CLS

DIM Array(20)           'create and fill a test array
FOR X = 0 TO 20
    Array(X) = RND(1) * 1000
    PRINT Array(X)
NEXT

Done = -1               'this is required to initialize Sort
DO
   PRINT ".";           'do anything you want here
   GOSUB BSort
LOOP UNTIL Done

FOR X = 0 TO 20         'show that it was sorted correctly
    LOCATE X + 1, 15
    PRINT Array(X)
NEXT
END

BSort:
```

(continues)

Figure 2: *An example showing how BASIC can be tricked into doing two things at once. In this case, an array is sorted at the same time a string of dots is being printed.*

```
    IF NOT Done GOTO MoreSort
    Size = UBOUND(Array, 1) - 1
    LoLimit = LBOUND(Array, 1)
    Done = 0
    FOR X = Size TO LoBound STEP -1
        FOR Y = LoBound TO X
            IF Array(Y) > Array(Y + 1) THEN
               SWAP Array(Y), Array(Y + 1)
            END IF
        NEXT
        RETURN        'exit after each pass
MoreSort:
    NEXT
    Done = -1
RETURN
```

(Figure 2 ends)

called Done. The example shown in SORT.BAS (Figure 2) shows how this can be applied in a BASIC program.

Even though jumping in and out of a FOR/NEXT loop is generally frowned upon, it in fact works with all versions of BASIC I tried. And of course, that's what really counts.—*Ethan Winer*

A Turbo Pascal program that lets you use your keyboard LEDs as a binary number indicator

One of my frustrations with the new 101-key AT keyboard is that the NumLock condition is on by default when I boot up. Since I'm still accustomed to using the numeric keypad for cursor control, I wrote a short Turbo Pascal program to reset the NumLock condition by resetting the NumLock bit in the BIOS shift byte (absolute location $0000:$0417). Of course, on the new keyboards, this turns off the NumLock LED indicator as well.

It occurred to me that I could use this method to display in binary any digit from 0 to 7, using the Caps, Num, and Scroll Lock indicators. The short program BINARY.PAS, shown in Figure 3, demonstrates this. It takes one parameter, an integer between 0 and 7, and displays it in binary on the Lock indicator LEDs. It takes advantage of the fact that the Caps, Num, and Scroll Lock bits in the shift byte have hex values $40, $20, and $10, respectively. Simply shifting the parameter value left by 4 places will set the appropriate bits. This trick can be useful while we're waiting for a debugger for Version 4. If your program is hanging in one of up to eight procedures, assign a number to each procedure and display the number each time the procedure is entered.—*Jeff Lamicela; North Syracuse, New York*

Rather than make you run the program again and again to check different numbers, I changed it to count slowly in binary. It runs through the numbers 0 to 7 continuously until you press a key. As Mr. Lamicela says, you can certainly use it to determine what procedure is in use at any given time, as long as you only need to track eight procedures. If the program gets stuck, a look at the LEDs will tell you where it's stuck. That's a good bit handier than inserting a lot of WriteLn statements.—*Neil J. Rubenking*

Productivity Tip

The original IBM PC video BIOS contains a nasty bug: the BP register is sometimes destroyed when an Int 10h is issued. Many programs will crash if BP is changed, but the fix is simple. Always Push BP before calling Int 10h, and then Pop it off again as the next instruction.

Keeping track of program modifications automatically in BASIC

On more than one occasion I have been working on one program, saved it and loaded another, and then accidentally saved the second program under the same name as the first one. This prompted me to add a line 50000 to all of my programs containing a statement such as 50000 SAVE "PROG.BAS".

However, I never seemed to know which listing of a program was the latest,

```
PROGRAM Binary;
USES Crt; {<== Comment out this line for TP3}
{ This program displays a binary number from 0 to 7
  using the Caps/Num/Scroll Lock LED indicators. }
TYPE  LEDnum = 0..7;
VAR   B : Byte;
      dummy : char;

  PROCEDURE BinLed(L : LEDnum);
  VAR ShiftByte : byte absolute $0000:$0417;
     { shift status byte }
  BEGIN
    ShiftByte := L SHL 4;
  END;

BEGIN
  WriteLn('Press a key to display binary numbers on the LEDs.');
  WriteLn('Press another key to stop the display.');
  dummy := ReadKey;  {<== comment out this line for TP3}
  {Read(Kbd,dummy);} {<== UN-comment this line for TP3}
  B := 0;
  REPEAT
    WriteLn('Displaying ',B);
    BinLed(B);
    Delay(1000);
    B := Succ(B) MOD 8;
  UNTIL KeyPressed;
  BinLed(0); {Turn off shift states!}
END. { PROGRAM Binary }
```

Figure 3: *Use your keyboard LEDs as a binary display.*

```
49999 END
50000 TS$ = "      "                  'number of times saved
50010 DS$ = "00-00-0000 00:00:00"  'Date & Time last saved
50020 VP! = VARPTR(TS$): TS! = VAL(TS$) + 1: GOSUB 50080
50030 FOR I=1 TO LEN(STR$(TS!)): POKE Z0!+I-1, ASC(MID$(STR$(TS!),I,1)): NEXT
50040 VP! = VARPTR(DS$): GOSUB 50080
50050 FOR I = 1 TO 10: POKE Z0! + I - 1, ASC(MID$(DATE$, I, 1)): NEXT
50060 FOR I = 1 TO 8: POKE Z0! + I + 10, ASC(MID$(TIME$, I, 1)): NEXT
50070 SAVE "PROG.BAS": RETURN
50080 Z0! = PEEK(VP! + 1) + 256 * PEEK(VP! + 2)
50090 IF Z0! > 32767 THEN Z0! = Z0! - 65536!
50100 RETURN
```

Figure 4: *An interpreted BASIC add-on that will automatically save the current date and time within a program listing.*

nor whether it matched the program I was currently working on. The solution I came up with is to save the current date and time within the program itself, as well as the number of times it has been saved.

The program fragment SAVE.BAS, shown in Figure 4, can be added to your own program and can be invoked by entering GOSUB 50000 whenever it is to be saved. Just be sure that your program does not contain any other variables with the name TS$ or DS$.—*Tom Low; Fort Worth, Texas*

This is a clever trick indeed. In a BASIC program, string variables are shuffled around in memory as they are assigned and reassigned. However, if the string is assigned only in the program listing and not used in any other assignment or INPUT statements, it will never move. Thus, when VARPTR is used to locate TS$ and DS$, the address returned will be that of their position within the source code. —*Ethan Winer*

Speed-read typed files in Turbo Pascal using BlockRead

There are numerous situations in which a typed file in Turbo Pascal must be read sequentially. For example, if we have a Products file in an Inventory program, we may want to sort it or to compute the total value of all products. I have found a way to reduce drastically the time required for such operations. The idea is quite simple: make the compiler believe that the file is untyped and use BlockRead instructions with a buffer that holds many records.

The method is best explained through an example. Suppose our program has the declaration ProductT, as in Figure 5. The standard procedure to calculate the total

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CIRCLE 116 ON READER SERVICE CARD

value of the Inventory would be something like the function Standard_Inventory_Value in Figure 5.

Instead of this standard approach, I use the function My_Inventory_Value, as shown in Figure 5. Notice first that there is a temporary buffer with the capacity to hold 500 products at once. The value 500 can of course be changed to anything that's convenient for the problem at hand. Since Buffer is a local variable, the memory it uses will be liberated as soon as we exit the Inventory_Value function; it does not eat up RAM permanently. Secondly, we define an untyped file F at the same memory address as Product_File. When the program is asked to operate on F, it will use the parameters (file handle, record length,

```
PROGRAM BlockReadDemo;
TYPE ProductT = RECORD
                  Part_Number : Integer;
                  Stock : Integer;
                  Price : Real;
                  Description : STRING[20];
 (* ...
 Other fields here ...
 *)
                END;
VAR
  Product : ProductT;
  Product_File : FILE OF ProductT;
  APrice : Real;
  FUNCTION Standard_Inventory_Value : Real;
    (* File must be RESET before calling this function *)
  VAR
    Value : Real;
  BEGIN
    Seek(Product_File, 0); Value := 0.0;
    WHILE NOT Eof(Product_File) DO
      BEGIN
        Read(Product_File, Product);
        Value := Value+Product.Price*Product.Stock;
      END;
    Standard_Inventory_Value := Value;
  END;

  FUNCTION My_Inventory_Value : Real;
  CONST BufferSize = 500;
  VAR
    Buffer : ARRAY[1..BufferSize] OF ProductT;
    F : FILE ABSOLUTE Product_File;
    Value : Real;
    i, RecsInBuffer : Integer;

  BEGIN
    Seek(F, 0); Value := 0.0;
    WHILE NOT Eof(F) DO
      BEGIN
        BlockRead(F, Buffer, BufferSize, RecsInBuffer);
        FOR i := 1 TO RecsInBuffer DO
          Value := Value+Buffer[i].Price*Buffer[i].Stock;
      END;
    My_Inventory_Value := Value;
  END;

BEGIN
  WriteLn('This program is strictly a demonstration.');
  WriteLn('It does nothing useful of itself.');
  Assign(Product_File, 'TEMP.$$$');
  ReWrite(Product_File);
  APrice := 1.0;
  FillChar(product, SizeOf(Product), 0);
  Product.Stock := 1;
  (*You may replace 100.0 with a larger number if you wish.*)
  WHILE APrice <= 100.0 DO
    BEGIN
      Product.Price := APrice;
      Write(Product_File, Product);
      APrice := APrice + 1;
    END;
  WriteLn('Typed-file function gives result ',Standard_Inventory_Value:1:4);
  WriteLn('UNtyped-file function gives result ',My_Inventory_Value:1:4);
  Close(Product_File);
  Erase(Product_File);
END.
```

Figure 5: *The function using BlockRead is substantially faster.*

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■ LANGUAGES

and so on) of our Product_File. However, because F is untyped, we are able to execute BlockReads on it.

The function first positions the file pointer at the beginning. Next, it reads records into the buffer 500 at a time. The loop over "i" performs the required additions. There is a potential problem as we reach the end of the file: there may be fewer than 500 records left for the last BlockRead. The "RecsInBuffer" variable (which returns the number of records actually transferred) handles this.

The improvement in performance is remarkable. For example, to read 4,000 records of length 49 on a regular PC (floppy disk, 4.77 MHz), I measured 1 minute 34 seconds for the first version of Inventory_Value and 22 seconds for the second version.

In other applications I have been able to reduce execution times by factors ranging from 4 to 10 , so the method is well worth the little extra programming effort.—*T. P. Eggarter; San Luis, Argentina*

Another virtue of using BlockRead is that you can easily give the file a header with useful information, such as the name of the index file or the beginning of a chain of deleted records. Declaring the untyped file ABSOLUTE on top of the typed file forces its block size to the type file's record size. Hence, the header's size must be an exact multiple of the record size. Suppose it takes the space of seven records. To set up the file for reading the first record, you'd use Seek(F,7) rather than Seek(F,0). To read the header itself, you'd seek to the start of the file and BlockRead(F,Header,7).—*Neil J. Rubenking*

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■ ROBERT L. HUMMEL

PC TUTOR

Load and execute programs using the DEVICE= statement; patch and create programs using the DEBUG W and N commands; and create and open files in BASIC.

A buzzing hard disk and an increasing number of bad clusters may not spell doom

I'm currently operating a Tandon PCX with a 20MB hard disk that I think may be going south. On occasion, when data is being sought from the hard disk, it seems like the heads get "stuck" and I get a continuous buzzing and a constant busy light. This continues for about 10 seconds. Most of the time the data is then read. But lately, the sticking will occur several times in succession, followed by a read error.

I've run the *Mace Utilities* REMEDY program several times a week for a couple of months, hoping it might lock out some random bad clusters. And it does—every time I run the utility I lose one, two, and sometimes more clusters. Currently, I have 158 bad clusters.

So, do I have a $300 anchor in my computer? If so, is there a way of installing and formatting the new drive, copying from the old drive to the new one, then removing the old one?—*Sal Pisano; Jamaica, New York*

From the events you describe, it's safe to conclude that you're headed for a disk crash. But, the crash may not be hardware related and, therefore, not as deadly as you may think.

A hard disk is simply a series of thin rings of magnetism (tracks) on a platter (surface). The ability to read the information on the disk depends to a great extent on how well the disk head lines up over the magnetized ring of data. Several things can affect the registration of the head and the data tracks, including thermal drift caused by expansion of metal parts, increased tolerance of parts caused by wear of the disk, and a change in orientation caused by turning the PC on its side.

The buzzing you hear from your hard disk is caused by the drive "recalibrating." This occurs after a hard disk error and is the hardware's attempt to regain its bearings. In this operation, the disk is stepped from the first track to the last. The head positioning motor causes this buzzing sound. This, and the increasing number of clusters reported as unreadable are bad news. Often, this problem can be completely eliminated by performing a low-level format of the hard disk, followed by partitioning (using FDISK), and a high-level format using the DOS FORMAT command.

A low-level format writes new magnetic tracks on the hard disk surface. Since the same heads that are doing the writing will be doing future reading, logic dictates that unless the hardware is damaged, the heads should be able to find your data on the new tracks. Low-level formatting procedures vary according to the type of disk, the manufacturer, and the type of computer that is being used, so check the documentation included with your computer.

■ Low-level formatting procedures vary according to the type of disk, the manufacturer, and the type of computer that is being used.

While most computers can support two hard disks, the difficulty involved in installing a second one temporarily makes the job undesirable. A much better idea is to simply buy and use a good backup program to make two complete backups of the data on your disk before the transfer. After switching the disks and formatting the new drive, simply restore the files.

Simple commands let users specify filenames in BASIC during program execution

I want to write a BASIC program that will create files whose names are typed in by the user while running the program. For example, if the user types SMITH in response to a prompt, a file named SMITH should be created with no further user intervention. Can you suggest a way to do this?—*Joszef Revai; Caracas, Venezuela*

The BASIC language contains many commands that make handling strings and opening files very easy. To solicit a name from the user and open a file, as in this case, we simply combine the two steps.

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■ PC TUTOR

The following BASIC instructions demonstrate how to prompt the user for a filename, then open a disk file by that name:

```
10 PRINT "Enter Your Last Name";
20 INPUT A$
30 OPEN A$ FOR OUTPUT AS #1
```

Line number 10 displays a prompt that instructs the user to enter his name. The name is captured and stored in the string variable A$ in line 20. This same variable is then used as the filename in line 30 to open the file in the current directory on the current disk.

This example, however, is very crude and would need substantial beefing up before it could be used reliably. Note that no check is performed on the data that is typed in. This checking process is known as *input verification;* a good program will check for several error types. For example, the program user may type in a name that has more than eight characters or that contains illegal characters. These errors should be detected, or *trapped,* before allowing the program to continue.

The DEBUG W and N commands work together when patching programs or creating small files

In the DOS manual we are told to carefully specify in registers BX and CX how many bytes to write when using the DEBUG write command (W). I realize that BX is almost always 0 unless the program is huge; however, some authors say to calculate the total bytes but then don't do it themselves. Others say to use the name command (N) just before the write command. I suspect that doing this sets the PSP (program segment prefix). Still others leave a space before the write command and say that it is necessary.

How do you handle the W command if you have modified a program? Please explain the correct procedure and show the shortcuts and the consequences of any possible mistakes.—*Eldon E. Thompson; Two Rivers, Alaska*

When interacting with the DOS environment, there are two file characteristics that concern DEBUG. These are the file's name and its length.

The name command (N) performs the same function as the original DEBUG command tail. You normally start DEBUG with a command such as

```
DEBUG A.COM B.COM C.COM
```

where A.COM is the program being debugged and where B.COM and C.COM are arguments to the A program. DEBUG loads A.COM, then formats the two default file control blocks (FCB) located at PSP:5Ch and PSP:6Ch with the names B.COM and C.COM.

The DEBUG command

```
N A.COM B.COM C.COM
```

sets DEBUG's internal name data area to A.COM and formats the two FCBs with the names B.COM and C.COM. The internal name is used whenever a write (W) or load (L) command is used. Note that the N command doesn't actually load A.COM. To perform the same function as the command line, the two commands would be

```
N A.COM B.COM C.COML
```

In DEBUG scripts, the N command is used to set the current DEBUG filename to some desired value just prior to writing it to disk. DEBUG doesn't care if the N is separated from the filename by a space. The N command may be issued anytime, as long as it is used before a W or L command that requires it.

DEBUG keeps track of the file's length as a 32-bit number in the register pair BX:CX. Note that this isn't a segmented number like an address. The low 16 bits are kept in the CX register, and the high 16 bits are kept in BX. For files up to 64K in length, therefore, BX will be 0.

When a file is loaded at the command line or with a combination of the N and L commands, the BX:CX register pair holds the file size. If you are modifying files, you should write these numbers down right away in case they get changed. If you don't execute any instructions, however, the registers will be the same and needn't be respecified.

As an example, assume you have modified a program called TEST.COM without changing its length (the most common occurrence). You now want to write out the modified version of the file under a new

name. Use the following commands:

```
DEBUG TEST.COM ... (modifications)
...N TEST2.COMWQ
```

Changing the length of an existing file using DEBUG isn't a common type of modification. You can't move code without changing all relative jumps and absolute references in the code—an unreasonable task.

Forgetting to set the BX and CX registers is the most common mistake made when patching with DEBUG. If you have executed any of the assembly instructions, they may have changed the registers. Thus the file written to disk may be truncated or extremely large, depending on the value of BX:CX.

Adding a second hard disk to a Compaq is an expensive upgrade

Can I install a third-party hard disk in a Compaq computer? If so, is some kind of adapter available to work with the Compaq controller, or do I need to buy a new controller?—*Paul R. Peterson; Columbia, Maryland*

Unlike IBM, which used a standard hard disk controller card and standard ST-506 interface disk drive in its AT, Compaq chose to use a proprietary hardware combination. The end result is that adding a second hard disk to an existing Compaq computer is a very expensive proposition.

Your first option is to buy your second hard disk from Compaq at a high cost relative to standard disks. Your second option is to discard your original Compaq hard disk and controller and replace them with a new controller and new hard disk.

The reason for this incompatibility is that Compaq places part of the controller circuitry for the hard disk on the hard disk itself. This renders both hard disk and controller useless and noninterchangeable with the industry standard.

How to load and execute a program using the DEVICE= statement

I have written a Turbo Pascal program that I would like to run from DOS's CONFIG.SYS file. Is it possible to compile the program to a .COM or .EXE file, insert the compiled program name into a DEVICE= statement in CONFIG.SYS, and run it? I have seen .COM files used in DEVICE= statements, so apparently device names are not restricted to extensions of .SYS in a CONFIG.SYS file.—*Thomas J. Hilgen; Omaha, Nebraska*

Other than that it must be a valid DOS filename, DOS places no restriction on the filename or extension following a DEVICE= statement in the CONFIG.SYS file. But the contents of the file must meet very specific requirements and cannot be a normal .COM or .EXE file.

To load and execute a file using DEVICE= the file must be a device driver. Next to writing memory-resident programs, writing device drivers is the most challenging aspect of programming for the IBM PC family. More information about writing device drivers can be found in the IBM Disk Operating System *Technical Reference* and in my favorite reference, *MS-DOS Developer's Guide*. For a programming example of a working device driver, see CONFIG.CTL (Utilities, *PC Magazine*, November 29, 1988).

Correction

The CTRLCAP.COM program, which was mentioned in this column in the October 31, 1988, issue of *PC Magazine*, displayed garbage on the screen when loading. A corrected version, and a somewhat neater one, is available on PC MagNet.

Ask the PC Tutor

The PC Tutor solves practical problems, explains points of general interest about using your hardware and software more productively, and answers basic questions about DOS and systems in general. To have your questions answered here, write to PC Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016 or upload them to PC MagNet (to join, see the "By Modem" sidebar in the Productivity section). We're sorry, but we cannot answer questions personally. PC

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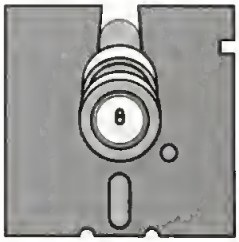

Using WordPerfect on a LAN can be easier; a tip about the future of LANs; batch files that will make NetWare's log-in process run smoothly.

Automate *NetWare*'s log-in process with these batch files

One of my first problems as a new *NetWare* administrator was how to automate the log-in process. My solution is contained in the AUTOEXEC.BAT file shown in Figure 1. (This should be located in the root directory of each workstation's boot disk.)

The first thing I did was to set the environment variable LOGDRIVE equal to the first network drive for this workstation. If the file NET$LOG.DAT is found on the PUBLIC directory, you are currently logged in, so you are then logged out. Any file that can be accessed by everyone logged on to the network can be used in place of NET$LOG.DAT.

If the file LOGIN.COM is not found in the LOGIN directory, *NetWare*'s shell is not loaded, and the program calls the NETBOOT command. This command allows the workstation to access the network. If the file LOGIN.COM is still not found on the network drive, there is an error condition. The program makes the LOGIN directory the current directory on the first network drive. Then it calls the RELOG.BAT program that is shown in Figure 2.

RELOG.BAT, located in the LOGIN directory of the first network drive, globally alters aspects of the network booting process and allows a user to relog onto the network under another account. As does AUTOEXEC.BAT, RELOG.BAT first sees if NET$LOG.DAT is available. If it is, the program must log out of the network. If the log-in command is successful, then the Novell log-in script(s) will be executed for the specified user. The program sets the search drives for all the necessary applications and sets a search drive specific to each user. For example:

```
MAP S3:=SYS:USERS\CHIP
```

If the log-in was not successful, then the program displays an error message and jumps back up to step 2. (If your text editor will support it, you can embed a Control-G command in the ECHO statement so that the error will beep at the user). If USETUP .BAT can be found, the RELOG.BAT file will execute it underneath another command shell. This batch file contains user-specific log-in instructions. (In the Novell log-in script, I map each user to his own di-

```
ECHO OFF
CLS
IF EXIST %LOGDRIVE%\PUBLIC\NET$LOG.DAT LOGOUT
IF NOT EXIST %LOGDRIVE%\LOGIN\LOGIN.COM NETBOOT
IF NOT EXIST %LOGDRIVE%\LOGIN\LOGIN.COM GOTO ERROR
CD %LOGDRIVE%\LOGIN
F:RELOG
:ERROR
CLS
ECHO An error has occurred linking up with the network, See
ECHO System Supervisor.
```

Figure 1: *A sample AUTOEXEC file that automates the log-in process on a* NetWare *network.*

```
ECHO OFF
CLS
IF EXIST %LOGDRIVE%\PUBLIC\NET$LOG.DAT LOGOUT
:LOGIN
%LOGDRIVE%LOGIN
IF EXIST %LOGDRIVE%\PUBLIC\NET$LOG.DAT GOTO DO_MENU
ECHO [ See the system supervisor for help ]
GOTO LOGIN
:DO_MENU
IF EXIST USETUP.BAT COMMAND /C USETUP
MENU
```

Figure 2: *The RELOG.BAT file is called by the AUTOEXEC file in Figure 1 and globally changes aspects of the network booting process.*

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rectories. Each one of these directories can have its own USETUP.BAT file). Finally, the batch file executes any MENU program that you choose.—*Dave Bennett; Independence, Missouri*

These batch files are a good demonstration of how you can effectively automate and hide the arcane details of the network log-in process from your users.

Productivity Tip

This year standards will take control in the LAN industry. Users will be able to mix and match products (adapters, operating systems, protocols, drivers, and so forth) that are produced by several different companies. But many companies will not survive the transition to marketing "commodity" products and their hopes will become orphans.

Tips that can make using *WordPerfect* on a LAN glitch-free

The network version of *WordPerfect* 4.2 requests a username when it starts. But on occasion, a user may make a mistake when typing in his username. Because *WordPerfect* sets printer selection based on the username, his print jobs are routed to the wrong printer!

Our users were already entering the first three characters of their network log-in name when *WordPerfect* requested its username. So, to me, using *WordPerfect*'s /U switch in combination with an environment variable set to contain the user's network log-in name furnished an elegant solution to the problem.

WordPerfect sets printer selection, and a long list of other parameters, by matching the username to file ???}SYS.FIL on the user's default directory. If a file match is not found, default settings from the file {WP}SYS.FIL in the *WordPerfect* program directory are used instead. (In retrospect, I could have set printer number 1 in the {WP}SYS.FIL file to a local printer. Although a user's print job may not have printed correctly, it would have, at least, printed locally.)

The username is also used by *WordPerfect* as the first three characters in its temporary, overflow, and timed-backup filenames. Since DOS does not allow two files in the same directory to have the same name, *WordPerfect* also cannot accommodate two or more users starting it from the same directory and entering the same username. Of course, two or more users entering different usernames can start *WordPerfect* from the same directory.

A username may range in length from one to three alphanumeric characters. *WordPerfect* will replace blanks in a username with the underscore character. Most

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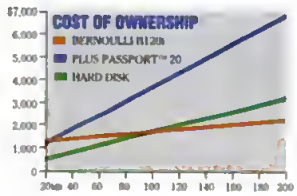

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importantly, the function of the *WordPerfect* username is not related to that of the network log-in name. My *WordPerfect* batch file now contains

```
@Echo off
WP/R/NK/U-%USER%F:CD\%USER%
```

The /R in the second line of this statement tells *WordPerfect* to load 120K of menus, error messages, and overlays from WP.EXE into memory. This speeds up parts of the program. The /NK allows *WordPerfect* to work with keyboard speedup programs such as *Cruise Control* or *Repeat Performance*.

Finally, /U-%USER% instructs *WordPerfect* to look in the DOS environment for the variable USER. *WordPerfect* then sets its username to the value of the variable USER and finishes loading without pausing to request a username entry! F: and CD\%USER% return the user to their Home drive and directory—just in case they changed their default drive and/or directory while in *WordPerfect*.

I used *NetWare*'s system log-in script, which is available through the Syscon program, to set the environment variable USER equal to the user's network log-in name. I inserted

```
SET USER="%LOGIN_NAME"
```

near the top of the file. Finally, *WordPerfect* won't hiccup if the USER value is more than three characters long.—*Roy T. Mendoza; Irvine, California*

WordPerfect is scoring a big hit with its LAN products. Their popularity seems to be growing quickly despite the fact that the programs are not simple to set up or administer on a LAN.

These comprehensive hints should help administrators avoid some of the frustrations we experienced setting up a new copy of *WordPerfect Office* for evaluation. We liked the product once we got all the files with their funny names tucked into the right subdirectories.

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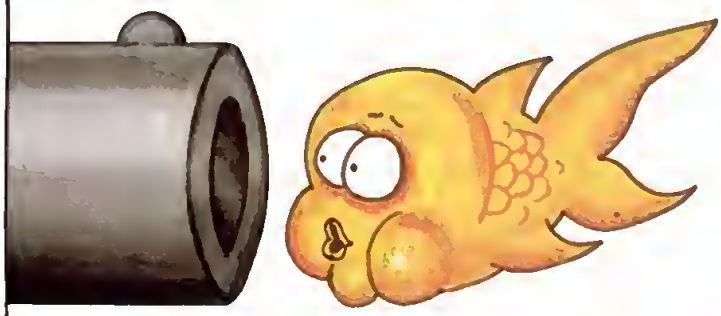

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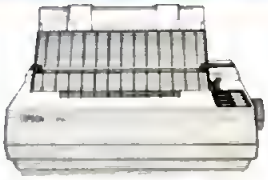

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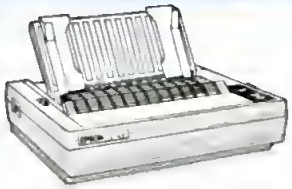

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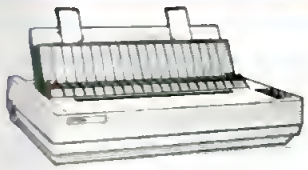
- 264 Characters per second in the high-speed draft mode delivers outstanding productivity
- 88 Characters per second in Letter Quality mode for enhanced, high-resolution characters
- In draft mode or Letter Quality mode, the LQ-850 runs at a surprisingly quiet 55 dB noise level



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- Epson's SmartPark™
- 264 Characters per second in the high-speed draft mode delivers outstanding productivity
- 88 Characters per second in Letter Quality mode for enhanced, high-resolution characters
- In draft mode or letter quality mode, the LQ-1050 runs at a surprisingly quiet 55 dB noise level
- Exclusive SelecType front control panel offers quick, easy selection of popular typestyles, fonts and pitch

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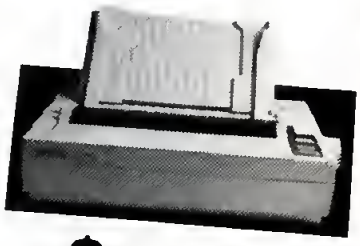

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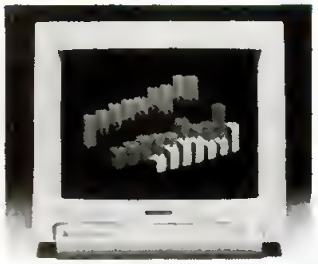

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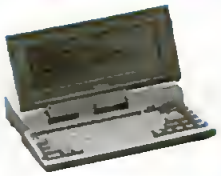

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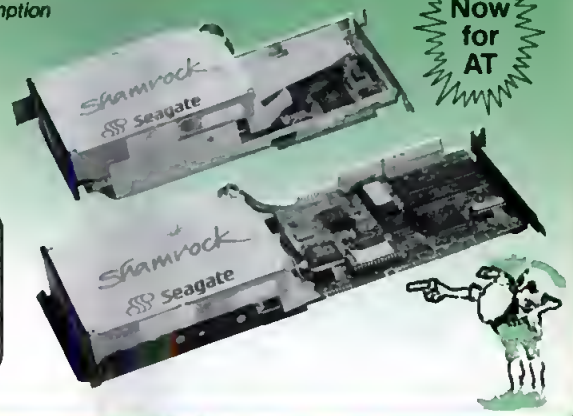

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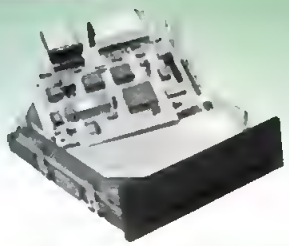

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286[12] Computer

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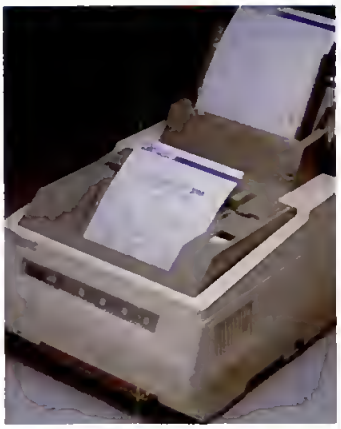

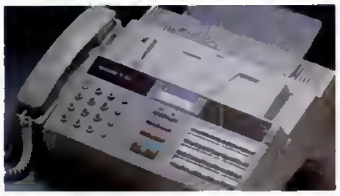

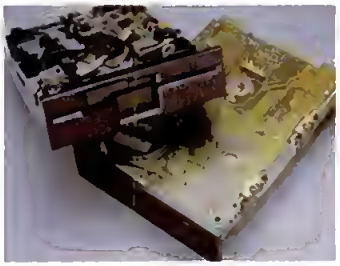

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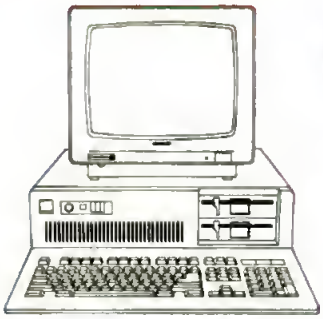

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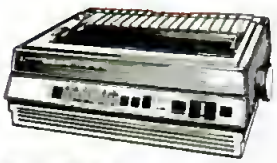

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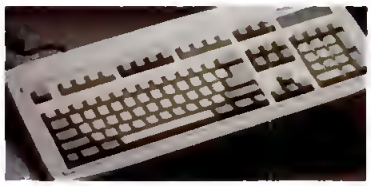

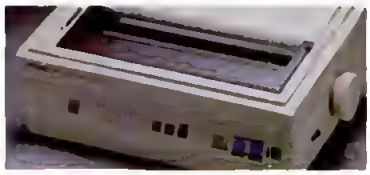

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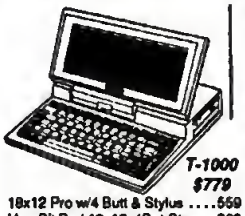

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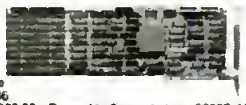

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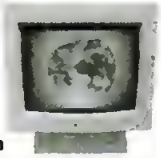

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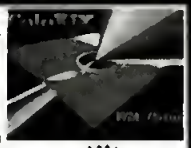

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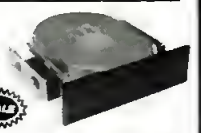

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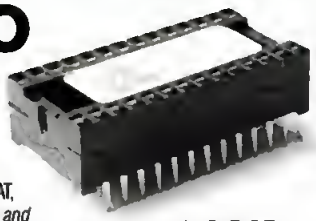

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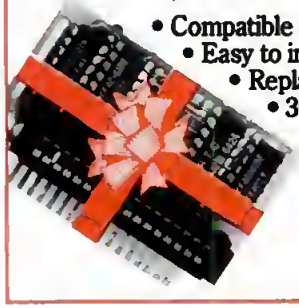

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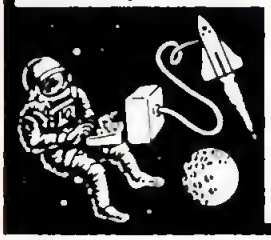

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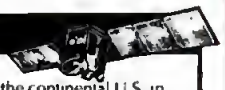

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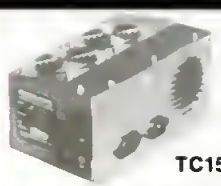

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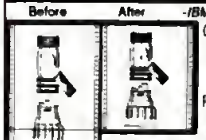

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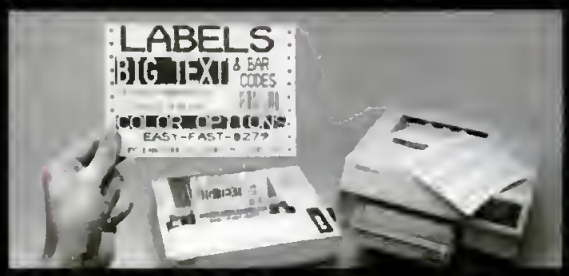

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COMING UP

LOW-COST LANs The gamut of network configurations runs from the helpful but relatively slow zero-slot LANs to high-end, non-DOS-based systems like Banyan's *VINES* and Novell's *NetWare*. In terms of price and performance, there's a happy medium: low-cost LAN packages, which offer a simple way to share disk files and printers. PC LAN Labs tests 11 low-cost packages, including Novell's *ELS NetWare II*, *LANtastic*, *TOPS/DOS*, and Western Digital's *ViaNet*. These inexpensive alternatives to data sharing (an average price of $350 per workstation) use DOS-based file servers that often double as workstations and permit the same data files to be accessed simultaneously. Additionally, a guided tour through the typical system's installation will help you avoid some of the common pitfalls and figure out which type of system is best suited to your particular needs.

DESKTOP SCANNERS What started as a handful of specialized scanning systems has grown into a mass market of over 150 hardware and software products. The popularity of desktop publishing has helped to create an image-hungry market, and, as scanner sales have more than quadrupled in the past 5 years, the number of vendors and the list of sophisticated features grow by leaps and bounds. Don't miss *PC Magazine*'s in-depth look at 21 desktop models, along with an overview of the scanner market and its future.

SWIMMING THE MICRO CHANNEL After the promise of an explosive start, the deluge of computers compatible with IBM's Micro Channel architecture never really came about. Manufacturers withdrew from the market and redrew their plans. The bright future of the Micro Channel turned turbid with speculation—until the recent debut of the Tandy 5000 MC, a product that may help set the pace for others to come. Contributing editor Winn L. Rosch dissects the first MCA-compatible computer to be shipped in America by a non-IBM manufacturer and looks at products due from ALR, American Mitac, and CompuStar.

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1. In which of the following sectors does your organization operate? (Check one.)
- o. ☐ Private Industry
- b. ☐ Government
- c. ☐ Education

2. Your primary job function is (check one):
- d. ☐ MIS/DP, Communications Systems, Programming
- e. ☐ Engineering/R&D
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3. Is your company a reseller?
- i. ☐ Yes
- j. ☐ No

4. For how many IBM PC s and compatibles do you specify brands of products?
- k. ☐ 10 or less
- l. ☐ 11–25
- m. ☐ 26–100
- n. ☐ 100 or more

5. Are there any PC s in your office? (Check all that apply.)
- o. ☐ Linked to mainframe
- p. ☐ Linked to mini
- q. ☐ Networked together

6. Does your company own
- r. ☐ Mainframe(s)
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7. Do you plan to buy any PC products?
- t. ☐ Now
- u. ☐ In 4 to 6 months
- v. ☐ In 6 to 12 months
- w. ☐ No definite plans

8. Number of employees in your entire company?
- x. ☐ 25 or less
- y. ☐ 26–99
- z. ☐ 100–499
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533	Kensington Microware LTD.	Power Protection	17
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471	Software Directions	Software Security Program	58
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232	American Technology Labs	Disk Saver	220
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266	Gentech	Mail Order	311
382	Intelligent Microsystems	Mail Order	251
243	Jade Computer Products	Mail Order	398
346	Jameco Electronics	Mail Order	404
387	MHI Warehouse	Mail Order	403
129	Micro Warehouse	Mail Order	118-119
•	MICROBEST	Mail Order	372
389	Olden Computers	PC's	407
•	PC Connection	Mail Order	208-213
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206	Telemart	Mail Order	86-87
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355	Business To Business	Mail Order	395
252	Clone Computers	Mail Order	402
109	Computer Discount Warehouse	Mail Order	406
243	Jade Computer Products	Mail Order	396
346	Jameco Electronics	Mail Order	404
387	MHI Warehouse, Inc	Mail Order	403
•	MICROBEST	Mail Order	372
389	Olden Computers	Mail Order	407
295	RP Systems	Mail Order	398
184	Shamrock	Mail Order	397
220	Tenex Computer Express	Mail Order	407
353	The New PC Network	Mail Order	399
535	The New PC Network	Mail Order	400-401
105	USA Flex	Mail Order	394-395

AFTER HOURS

TaxEase

(continued)

List Price: *TaxEase*, $79.95 (including one federal and one state module); $69.95 (federal alone); $59.95 (second state module); $49.95 (third state module). **Requires:** 256K RAM (with *Lotus 1-2-3*, Release 1); 384K RAM (with *Lotus 1-2-3*, Release 2.01); DOS 2.0 or later. Not copy protected. Park Technologies Inc., P.O. Box 1317, Clifton Park, NY 12065; (518) 877-5881.

CIRCLE **640** ON READER SERVICE CARD

640K of memory, 2.5MB of hard disk space, and the *Windows*-compatible mouse that makes *TaxView* strut its stuff.

Despite my unfamiliarity with mice, I soon was whizzing from form to form and dragging windows out of the way of text I wanted in sight.

In operation, *TaxView* displays graphically accurate representations of black-on-white tax forms on your screen. It also includes general IRS instructions for each form as a whole, as well as specific line-by-line instructions. An intriguing con-

The TaxEase screen of schedule A with the cursor on the line showing the limitation on medical deductions. The formula to calculate it is in the upper-left corner.

TaxView

With its beautiful screens and a manual full of tantalizing features, I really wanted to love *TaxView*. It's the IBM edition, now in its second year, of the popular *MacInTax* program for the Macintosh. The software, which comes with a runtime version of *Windows*, resembles its Mac counterpart in that it requires a mouse.

Being a troglodyte product of the keyboard era myself, I consulted the company to see if the program would function without a rodent. At first its technical staff encouraged my endeavors, but it soon became clear to both of us that using the keyboard was just too awkward. So, with boundless optimism and obstinate determination, I sought out a machine with the verter can take your old 1987 *TaxView* numbers and put all the applicable ones onto your 1988 tax forms. (The converter feature is said to work with the California and New York state modules of *TaxView*, which I did not see.) An import command conjures up a window of text files created by spreadsheet, database, and personal finance programs, then lets you put one number at a time from the text file onto the tax forms.

You'll delight in the printed versions of your tax forms. The printout of an approved Form 1040 on my Hewlett-Packard LaserJet Series II without any special font cartridge was as slick as anything I've seen.

Beauty is only skin-deep, and I don't feel that *TaxView* has done its job when it asks me to choose whether to calculate my tax from the tax tables or the tax rate schedules, as *TaxView* does at line 37 of the 1040. There are relatively simple criteria that channel all taxpayers to one source or the other, and it's a simple task for a program to examine these factors and select the correct source. I should not have to look up the criteria and apply mathematical tests myself.

On the whole, *TaxView looks* great; its screens are attractive, its interface with the mouse is smooth, and its printing capacity is impressive. I wouldn't go so far as to say it's beautiful but dumb, but it doesn't seem to have the inner resources that would make me want to commit myself to a long-term relationship.

List Price: *TaxView*, $119; $65 per state module. **Requires:** 640K RAM, *Windows*-compatible mouse, DOS 2.0 or later. Not copy protected. SoftView Inc., 4820 Adohr Lane, Suite F, Camarillo, CA 93010; (805) 388-2626.

CIRCLE **639** ON READER SERVICE CARD

. . . AND IN CONCLUSION

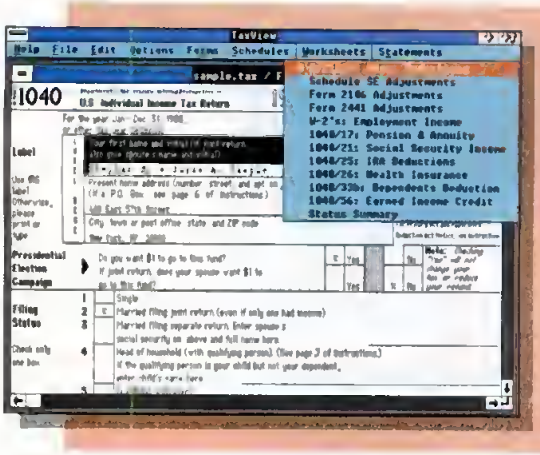
With this embarrassment of riches in tax-return programs, how do you choose?

First, consider whether you should purchase one at all. Is your return too simple to justify learning a fairly complex computer program? It definitely is if most of your income is shown on your Form W-2, if you have $400 or less of interest or dividends, and fewer deductions to itemize than the $3,000 standard deduction for singles or the $5,000 standard for married couples.

Or is your return too complicated? Many of the computer programs do math beautifully and print out splendid forms, but they don't think or make decisions for you. The programs can't tell you if or how much of your interest payments are deductible if you don't understand the difference between personal interest expense and home-mortgage interest expense. If you don't know much about taxes—and don't want to know—read the disclaimers on the software carefully. Then consider

Finding the Forms and Schedules You'll Need

	Forms	Schedules
AM-Tax	1040, 1040ES, 2106, 2119, 2210, 2441, 3800, 3903, 4136, 4137, 4255, 4562, 4684, 6251, 8582, 8598, 8615	A, B, C, D, E, F, R, SE
SwifTax	1040, 1040A, 1040EZ, 2106, 2441, 3903, 4562, 6251, 8598, 8615	A, B, C, D, E, F, R, SE
The Tax Advantage	1040, 2106, 2119, 3903, 4562, 6251, 8598, 8615	A, B, C, D, E, F, R, SE
TaxEase	1040, 1040X, 2106, 2119, 2441, 3800, 3903, 4136, 4255, 4562, 4684, 4797, 4952, 4972, 6251, 6252, 8582, 8598, 8606, 8615,	A, B, C, D, E, F, R, SE
TaxView	1040, 1040X, 2106, 2119, 2210, 2441, 2555, 2688, 3468, 3800, 3903, 4255, 4562, 4684, 4797, 4868, 4952, 6251, 6252, 8283, 8582, 8606, 8615, 8801	A, B, C, D, E, F, R, SE



TaxView's eye-catching screens are graphically accurate representations of tax forms. The pull-down menu lists some other worksheets, schedules, and forms available.

whether you need a pro rather than a program to prepare your return.

All tax-preparation programs take some time to learn. Like any software, the more the program does, the longer it takes to learn all of it. However, you may be able to do what you need short of investing the time to learn every single feature.

If you've used a tax program in previous years and are not dissatisfied, you'll save time if you stick with it instead of switching to another that might offer snazzier features. If you know you want to try out alternatives to your present software, record information in the new program a little at a time and see how it handles the grunt work. And if you've never used a tax program before but you suspect you need to, don't let the learning curve scare you off. If your contribution to family unity is to crank out your father-in-law's return and maybe Cousin George's, it's probably time to harness the computer to help. You'll suffer a lot less if your computer has a hard disk.

Some of the programs reviewed here have manuals that lay out in detail what happens to the entries, what formulas are applied, and how the results are carried over to the particular form or line: *TurboTax* is the most detailed, but *AM-Tax* makes a creditable effort in this direction. All very reassuring. As a tax lawyer, I like to know what the program is doing with my data.

A couple of the programs are so dedicated to tax simplification through clean screens that they make me feel I'm at one of those Esalen sessions, being led blindfolded by a stranger over rough terrain. It requires a lot of trust. While they may be worthy of my trust, I can't be sure without doing a complete check. Since I'm using betas rather than final programs for these reviews, a complete check isn't in the cards.

If you do want to be led through your tax return a few items at a time without distraction or confusing choices, *Andrew Tobias' TaxCut* seems best qualified to do the job.

This year, more than any other, the programs are adding new features. Some of the features do strike me as gilding the lily: the meticulous graphic imitation of an IRS form on screen when a typed version with the right line numbers will suffice. Other features are truly convenient: a personal interview that alerts you to the extra forms you might need to file, and having the IRS line-by-line instructions in an easily accessible window.

A few of the programs' features are in the break-through category—printing a Form 1040 that qualifies for filing with the IRS, an on-screen interactive Q & A that helps the intelligent layman make key tax decisions, and an import feature (found only in *The Tax Advantage*) that will put a year's worth of data into all the right places on tax forms and schedules.

I still have a few things on my wish list. If you are likely to owe an alternate minimum tax on preference income, no program will yet calculate the necessary Form 6152 without your further direct input. And few of these programs can accept all items directly from a partnership Schedule K-1 and put them in the right place unless you roll up your sleeves and provide more guidance. I'd also like to see a key that would alphabetize my lists of dividends, contributions, stock trades, and so on.

This year, I've narrowed down my choices to three favorites: *J.K. Lasser's Your Income Tax*, a relative newcomer, is a fine program with many convenient features that outdo some tax packages that have been around a lot longer. And I like *Ask Dan's* unique way of solving your tax riddles. However, it is *TurboTax*, with its broad range of fundamental functions and fancy features, that is hardest to beat. PC

Turning in Your Taxes

In the land of tax returns, the Form 1040 is sacrosanct. Each year, many neatly typed substitutes are bounced back by the IRS. But over the last couple of years, a few ambitious personal tax-return software programs have won IRS approval for the dot-matrix-facsimile Form 1040s they can produce. Of course, their print is still marred by those little jagged edges on all the curves.

So, for the pros or the persnickety, the best 1040 replica means buying one of the laser printer tax font cartridges on the market. With a laser, a tax font cartridge and compatible tax-return software, anyone can do the Government Printing Office one better.

Two hundred fifty dollars will get you Hewlett Packard's HP 92286T Tax 1 Font Cartridge, including nine fonts: Helvetica from 6 to 14 points, Courier, and something called Linedraw that creates boxes. I can testify that it works like a dream with the HP LaserJet Series II and a professional tax program.

Center Piece Software of Richmond, Virginia offers a fully compatible $239 Accounting & Tax Font Cartridge with all the fonts and capacities of the HP Tax 1 and then some. The Center Piece cartridge added 10-point Times Roman (regular and italic) and Elite (portrait and landscape) fonts, ASCII characters above 127, a compressed mode, and faster-printing bitmapped graphics instead of raster graphics.

With either the HP or the Center Piece font cartridge, you need a software file to tell the printer how to lay out the applicable form, including boxes, on the page. Your tax-return software then organizes the individual taxpayer's data to go in the right places on the form.

Of the personal tax-return programs reviewed here and in the last issue, only *AM-Tax* includes the Form 1040 layout instructions that speak to a tax font cartridge. (The ones qualified for filing 1040s that the other programs will turn out on a laser printer are produced by the same instructions the programs give to a dot matrix printer—and they have the telltale jagged edges on the curved lines).

Many professional tax-return programs on the market come with software files that access tax font cartridges or are compatible with printer driver software such as the *Nelco Laser Tax Form Software* (Green Bay, Wis. (414) 337-1000). These drivers can be bought separately from Nelco and put to work with your personal tax program. They're pricey, though—$400 for the complete federal 1040 set and $100 per state.—**Laura Lou Meadows**

The Tax Advantage

(continued)

and *then* put in your number.

Whether you've imported your data or entered it manually, you can add to or subtract from an entry by leaving the cursor on the same line and using the Plus or Minus keys. As you work along, a box at the bottom of the screen lists the choice of actions you can take at that point in the program. For example, pressing T for Taxes lets you see the amount of tax liability and amount owed at almost any point in the proceedings. You can access a line's supporting schedule or a general worksheet by pressing I (for Itemize). Your listings on the backup form or sheet will be toted up, saved, transferred to the tax form, and, if you specify, printed out at the end.

Printout time is a disappointment. The program never asks for a taxpayer's address on the grounds that it isn't able to do a Form 1040 that qualifies for filing with the IRS anyway. It also doesn't ask for your business address or several other items needed for the top of Schedule C. The end result is that you need to check every schedule printed to see if there is a pointer (>) in the left margin indicating that you need to fill in some information by hand. The IRS accepts these hybrids for the supporting forms and schedules, but it does look a trifle tacky.

The manual is fine on the mechanics of the program. But there are no on-line tax rules and not much beyond a four- to six-word general phrase when you press H for help. Also, no state tax programs are available.

List Price: *The Tax Advantage*, $59.95 **Requires:** 256K RAM, DOS 2.0 or later. Not copy protected. Double Eagle Software Inc., 2340 Plaza del Amo, #215, Torrance, CA 90501; (213) 212-6611.

CIRCLE **641** ON READER SERVICE CARD

TaxEase

If you're a *Lotus 1-2-3* veteran (or a *Quattro* or *VP-Planner* maven, for that matter), Park Technologies' $69.95 *TaxEase* just might be your tax-time salvation. With templates that transform a worksheet screen into a representation of Form 1040 and 25 supporting forms, *TaxEase* lets you use your spreadsheet skills to make (relatively) short work of your tax returns.

Run through the brief tutorial, and you'll be ready to start feeding in personal data such as name, address, and social security number. Next, use Alt-N to invoke a macro that will put this information where it belongs—at the top of all the forms.

Pressing F5 along with the number 1 will get you to the first page of the 1040. Fill in what you can and then jump to a supporting form by pressing F5 and the number or letter of the supporting form. Run the cursor down the left-hand "Magic Margin" until you come to any line marked by an asterisk; moving your eyes to the top of the screen at this point acquaints you with *TaxEase*'s modest version of help: a brief phrase of instruction.

While you are able to manually enter information in some of the cells, other cells are protected and take only calculated answers or information that is carried over from another form. The only way to unprotect these cells is to use the standard Lotus method.

The Alt-T and Alt-R macros open windows to show running totals of taxes due or refunds coming, respectively. If you're wondering what the program is doing to any entry, check out the *1-2-3* formula in the upper-left corner for the cell where the cursor rests.

The stellar feature of *TaxEase* is its capacity to do any one of some 25 state income tax returns. I tried the New York program for a New York City resident and was pleased to find that the program put all my federal data in the correct place on the New York tax form that covers the state and city.

A drawback of the *TaxEase* program is in the printout. This is another one of those programs that leave you to either transcribe your signature-form figures onto an official form by hand, adjust your printer to line up with the official form you feed in, or juggle your own transparent overlays with a photocopier and *TaxEase*'s printout of the figures alone. After all things have been considered, though, this is not a bad trade-off for the easy-to-run, inexpensive state programs.

(continues)

Tax-Preparation Programs: Summary Of Features

(Products listed in alphabetical order)

	AM-Tax $45.00 (reg.) $60.00 (adv.)	Andrew Tobias TaxCut $79.95	Ask Dan About Your Taxes $89.95	J. K. Lasser's Your Income Tax $69.95	SwiftTax $69.95	The Tax Advantage $59.95	TaxEase $69.95	TaxView $119.00	TurboTax $75.00
No. of optional state-tax modules	6	0	3	2	0	0	25	2	41
Includes preliminary interview feature to determine forms needed	○	●	●	●	●	○	○	○	●
Substantive on-screen tax help	○	●	●	●	●	○	○	●	●
Separate on-screen calculator	●	●	●	●	●	○	○	○	●
Calculations automatically carry over to other lines or schedules	●	●	●	●	○	●	●	●	●
Calculation override available	●	●	●	●	○	●	●	○	●
Has running tax totals	●	●	●	●	●	●	●	●	●
Imports data from financial programs	○	●	●	●	○	●	●	○	●
Prints submittable Form 1040:									
Dot matrix	○	●	○	●	●	○	○	●	●
Laser	●	○	○	○	○	○	○	●	●

●—Yes ○—No

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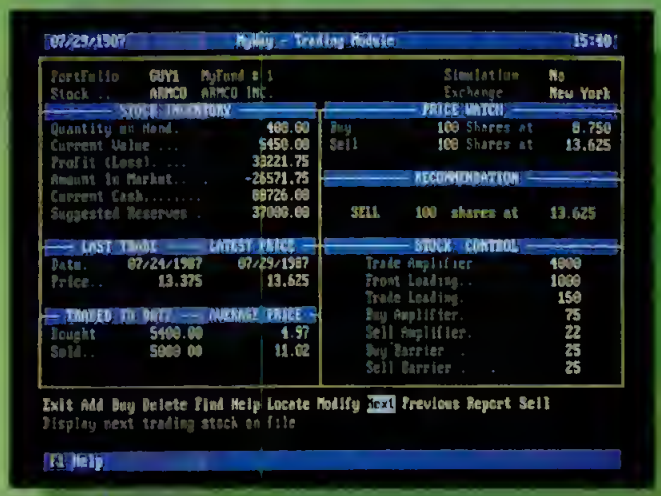

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AFTER HOURS

SwifTax

(continued)

wardly implemented, making the program clunky.

The program starts up with colorful screens that orient you to its menu system. It then brings up a screen that takes your basic personal data. I was encouraged to see 16 questions designed to determine the forms you'll need to file. Using my answers to the questionnaire, the program placed markers next to the listed forms that pertained to my tax scenario. Alas, when I tried to print my return results before I'd filled out all of the marked forms, *SwifTax* warned me that I needed to keep plugging away on my appointed rounds before I could see any hard copy.

Once past the questionnaire, the program puts portions of the forms on the screen; the cursor moves to blocks where entries are possible. When you get to a line where a supporting form is available, F5 takes you to that form. If there is no official form for the line, you can use F5 to create a list of items in a generic format in support of the entry. If you don't need to keep a record of the calculations, the on-screen calculator, invoked with Alt-C, does the arithmetic. Wipe the calculator away with the Esc key, then use Alt-T to transfer the result to the line.

In the beta version I worked with, F9 made the entries tote up on any of the forms. To link the total line of a supporting form with the 1040, first do a recalc with F9, then a save with F2, then Escape back to the 1040 and do another F9 recalc—a procedure I found to be awkward and uncertain. It took three tries to get the Schedule A to compute the limit on medical expenses—a figure which is 7.5 percent of the adjusted gross income from Form 1040.

To see the instructions copied from the IRS booklet that comes with the Form 1040, F1 invokes a window for each form supported. Although the IRS source documents have separate instructions listed on a line-by-line basis, *SwifTax* groups together all the instructions for a form. This means you have to scroll through until you arrive at the instruction for the line where your question came up.

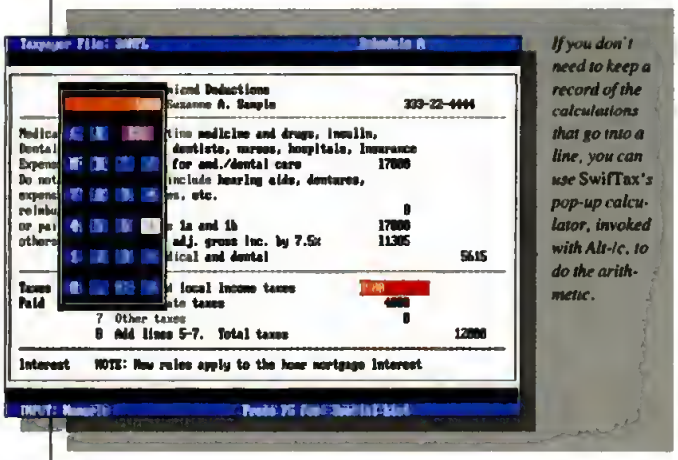
SwifTax has received IRS approval for its plans of a dot-matrix-style Form 1040 to be printed on a dot matrix or a laser printer. At this writing, this feature wasn't in working order.

List Price: *SwifTax*, $69.95.

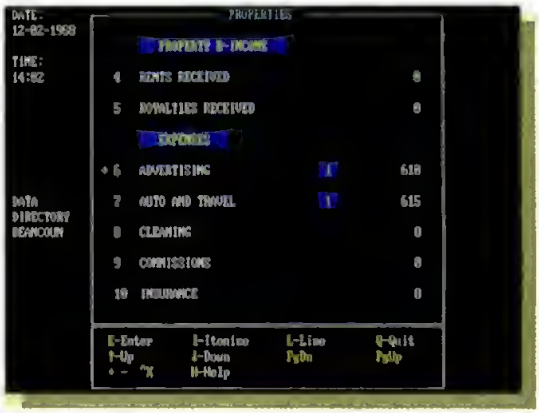
Requires: 512K RAM, DOS 2.1 or later. Not copy protected.

Timeworks Inc., 444 Lake Cook Rd., Deerfield, IL 60015; (800) 535-9497.

CIRCLE **642** ON READER SERVICE CARD



If you don't need to keep a record of the calculations that go into a line, you can use SwifTax's pop-up calculator, invoked with Alt-/c, to do the arithmetic.



The Tax Advantage sets out the numbers for a second property to be reported on Schedule E. The yellow I's indicate that an itemized list backs up the line.

The Tax Advantage

Yes, there is rest for the weary—if you've been worn to a nubbin putting all your income and expense items into the right kind of financial program. When April rolls around, take your file of carefully coded entries from Double Eagle's *Home Accountant*, Star/Monogram's *Dollars & Sense*, or *Andrew Tobias' Managing Your Money*, and feed them to Double Eagle Software's *The Tax Advantage* program. Presto, your entire tax return can be filled in and calculated in minutes.

Of all the tax-return programs purporting to import data from a financial program, the $59.95 *Tax Advantage* clearly has the edge. Unlike the other tax programs with data importing features, *The Tax Advantage* doesn't limit you to importing one number at a time. It can pick up an entire year's worth of your financial life in one swoop and put the total from each of your categories onto the proper line of the Form 1040 or a supporting form or schedule.

How does it perform such magic? Hard work, that's how. First, *you* have to do the heavy lifting of setting up your financial program with code numbers taken from Appendix B of *The Tax Advantage*'s manual. The code numbers are a cross between the Dewey Decimal System and an accountant's chart of accounts. Code numbers in the 100 series relate to lines of the 1040, the 200 series apply to deductions itemized on Schedule A, and so on.

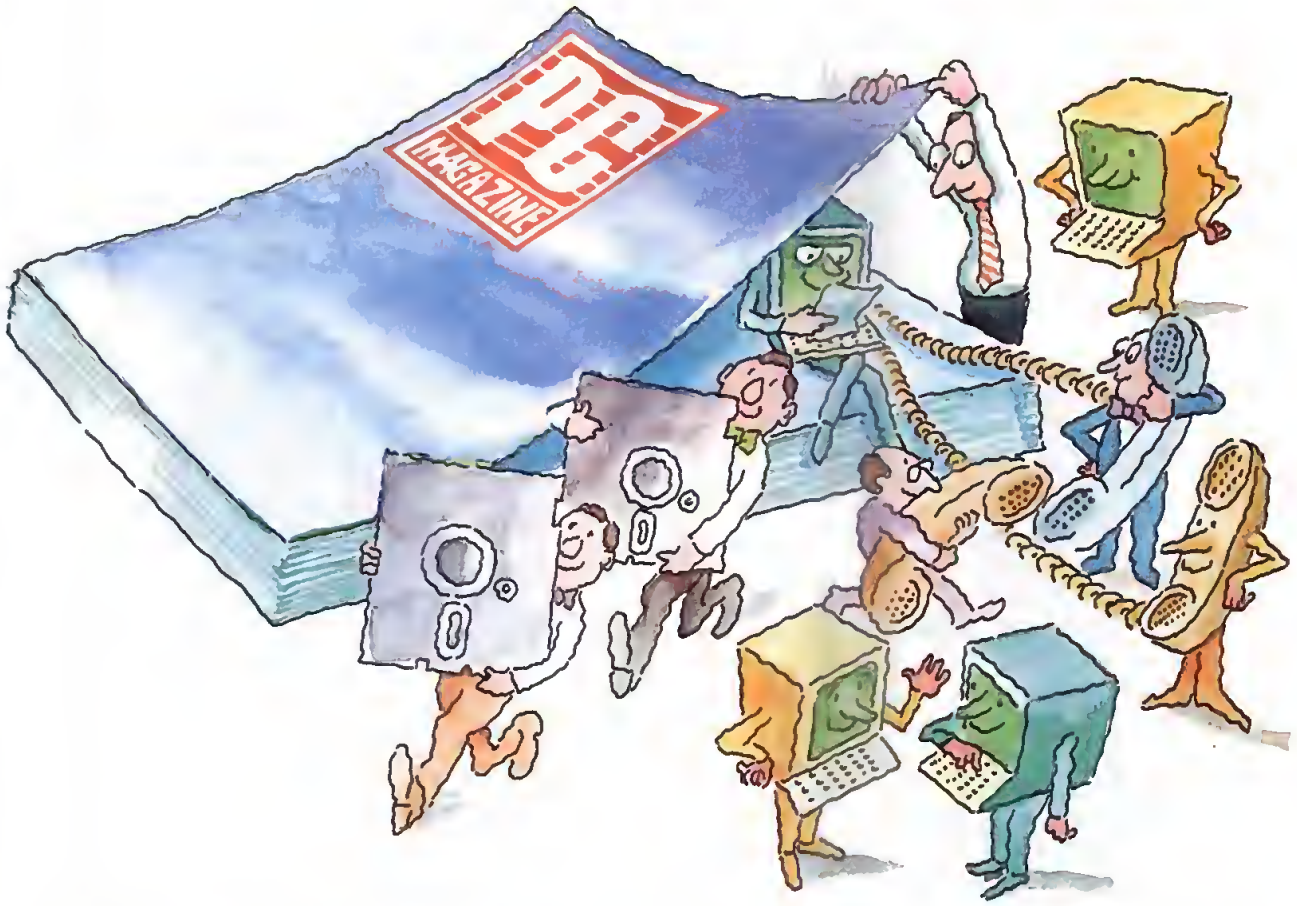
The beauty of this is that once you've performed this laborious exercise, your tax return can be a snap—as long as you've chosen categories that match the tax definitions and have been making meticulous entries during the year.

After I got the hang of the program, I imported data from a *Dollars & Sense* file. To my pleasure, *Tax Advantage* screens presented a moderately complicated return with 26 items properly dispersed over the 1040 and Schedules A, B, three Cs, E with several properties, and F; Forms 6251 and 2106. Whew!

If you were less than perfect in making the year's entries in your financial program, *The Tax Advantage* lets you go through checking and editing the imported information. Special symbols on the screen show you that an entry was imported.

If you haven't been entering your data in a financial program all year, you'll have to input it manually, and this can be somewhat awkward. After selecting the 1040 or one of 15 supporting forms from the main menu, you use the arrow keys to put the cursor where you want to make an entry, then press E for Enter,

(continues)



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(Note: After you have become a member, you can locate a local telephone access number, or 2,400-bps service, by typing **GO PHONES** at the ! prompt.)

2. When you receive a Connect or Carrier Detected message, enter **Ctrl-C.**
3. At the HOST NAME prompt, enter **CIS.**
4. At the USER ID prompt, enter **177000, 5000.**
5. At the PASSWORD prompt, enter **PC*MAGNET.**
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TAX SOFTWARE

Countdown to April 15: Five More Personal Income-Tax Programs

BY LAURA LOU MEADOWS

In our last issue, we surveyed four personal income-tax packages. The series continues with a look at five more programs: *AM-Tax*, *SwifTax*, *The Tax Advantage*, *TaxEase*, and *TaxView*.

AM-Tax

The big news from AM Software is its $60 advanced version of *AM-Tax*, which has the most proficient printing capacity of any personal tax-preparation software I've seen this year. *AM-Tax Advanced*, which is supplied on two disks and takes up 320K of memory, will print a high-quality IRS-approved version of the Form 1040 on several dot-matrix printers or make an almost photographic replica on a laser printer equipped with the Hewlett-Packard HP92286T Font Cartridge. (See the sidebar "Turning in Your Taxes" for more on tax font cartridges.)

For a down-to-earth, no-nonsense tax-return program, the regular version of *AM-Tax* continues to fill the bill. *AM-Tax* keeps the price for its regular one-disk version down to $45 and the memory requirements down to 256K. The *AM-Tax* regular version is acceptable for filing printouts of supporting forms and schedules, but when it comes to the Form 1040, it is limited to printing a draft (from which you can hand-copy the numbers onto an official Form 1040), putting the information on blank paper to use with overlays and photocopiers, or printing directly to a special Form 1040 purchased from a forms supplier.

In operation, both *AM-Tax* menus start you off with questions arranged so that the information you input will follow Form 1040 sequence. The screens are relatively clean, with the use of the function keys clearly displayed on a line at the bottom.

When you arrive at a line on the 1040 marked by an asterisk (meaning that it can use one of the 24 supporting schedules or specific worksheets), you can either use F6 to take you to the necessary form or fill in an amount you've calculated manually. When you reach a line that does not use numbers from an official supporting schedule or worksheet, you still may want to use F6 to bring up a general worksheet to itemize the components and carry the result directly to the line. Use the pop-up on-screen calculator if you need to do some arithmetic but don't need to save the backup.

Lines marked with a C are automatically calculated by the program, and in most cases the cursor won't stop at them. If the cursor does stop, it means that you can override the program's calculations if its assumptions don't apply to you.

The *AM-Tax* screen doesn't let you choose from a list of its 24 forms and schedules, but it picks the right forms for the information you enter. Then the directory lists the forms your input has generated.

For the situations it handles, *AM-Tax* builds the applicable tax rules into the program. There are no substantive tax instructions available on-screen or in the manual; *AM-Tax* assumes you will read any explanations you need about the tax rules elsewhere. The help feature invoked with F1 pertains only to the function-key features. Everything else you need to know about the mechanics is well handled in the manual.

For the knowledgeable or the nervous, Appendix C of the manual tells you what the program is doing in the way of carrying totals from a supporting schedule to the 1040 or about the formula being applied. For example: for Form 2106 (Employee Business Expenses), line 13 (which deals with fully deductible expenses), Appendix C explains "Expenses that are reimbursed by your employer and reported on your W-2 are transferred to line 23 of Form 1040. This amount will be subtracted from gross income."

File handling of returns for multiple taxpayers works like a breeze from a directory within the program. Programs for six states were not available in time for this review.

List Price: *AM-Tax Advanced*, $60; *AM-Tax*, $45. **Requires:** Advanced: 320K RAM, hard disk, HP 92286T Font Cartridge (for IRS-approved 1040 laser printouts), DOS 2.0 or later. Regular: 256K RAM, DOS 2.0 or later. Not copy protected. AM Software, P.O. Box 25010, Kansas City, MO 64119; (816) 452-2127.

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AM-Tax's 1040 shows the automatically calculated penalty for underpayment of estimated and withholding taxes. Function key assignments appear at the bottom.

AFTER HOURS INDEX

AM-Tax
Stresses high-quality IRS-approved laser printouts.

SwifTax
Takes care of the basics in tax preparation.

The Tax Advantage
Shines at importing data from financial-management programs.

TaxEase
A tax template for *Lotus 1-2-3*, *Quattro*, or *VP-Planner*.

TaxView
Load *Microsoft Windows*, grab a mouse, and get to work.

SwifTax

SwifTax, a $69.95 package from Timeworks, will perform the basic arithmetic operations you need on the ten tax forms it supports. Unfortunately, some of the features have been awk-

(continues)

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